Evaluating the use of a student response system in high enrollment anatomy lectures

Geertsen, Svend Sparre

Published in:
Improving University Science Teaching and Learning

Publication date:
2015

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Geertsen, S. S. (2015). Evaluating the use of a student response system in high enrollment anatomy lectures. In L. Ulriksen, & J. Sølberg (Eds.), *Improving University Science Teaching and Learning: Pedagogical Projects 2014* (pp. 99-112). Department of Science Education, University of Copenhagen. Improving University Science Teaching and Learning - Pedagogical Projects Vol. 7 No. 1-2 http://www.ind.ku.dk/publikationer/knud/2014-7/

This is number one and two in the seventh volume in a series of publications of educational development projects made by participants in the teacher development course for assistant professors and post-docs held by the Department of Science Education, University of Copenhagen

The aim of the series is to provide insight into the kinds of educational tasks and problems new teachers are facing, and to show how they manage them in inspiring ways.

University of Copenhagen

Improving University Science Teaching and Learning – Pedagogical Projects 2014, vol. 7, no. 1-2

UNIVERSITY OF COPENHAGEN
DEPARTMENT OF SCIENCE EDUCATION

Improving University Science Teaching and Learning

Pedagogical Projects 2014

Volume 7, Number 1-2

Lars Ulriksen
Jan Sølberg

Improving University Science Teaching and Learning

Pedagogical Projects 2014

Department of Science Education
University of Copenhagen

Published by the Department of Science Education, University of Copenhagen, Denmark

E-version at http://www.ind.ku.dk/publikationer/knud
Printed at www.lulu.com
Typeset in LaTeX

The anthology can be bought through the marketplace at http://www.lulu.com

Improving University Science Teaching and Learning – Pedagogical Projects 2014, vol. 7(1-2). ISSN: 1904-2000

Contents

Preface
Lars Ulriksen ix

Part I Planning, designing or redesigning units, courses or programmes

1 Implementering af forelæsninger som hjælp til laboratorieøvelse på første års kemikursus
Christian Bukh 3

2 Use of a proof assistant as a learning tool in an introductory logic course for computer science undergraduates
Holger Bock Axelsen 13

3 Developing the course "Assessment of Insulin Sensitivity in Metabolic Active Tissue"
Sara Gry Vienberg 33

4 Global Studies in a Material World - How far can Natural & Social Sciences Integrate?
Henrik Egelyng 43

Part II Evaluating and revising existing courses or units - course development

5 Increasing collaborative learning and knowledge exchange in a case-based learning environment
Stéphanie Horion 61

6 Historical teaching and learning practices for first-year English undergraduates – reflections for improving historical thinking
Celia Penelope Hughes 71

7 Revising a Bachelor Program in Astronomy
Kjartan Münster Kinch 87

8 Evaluating the use of a student response system in high enrollment anatomy lectures
Svend Sparre Geertsen 99

9 When fear takes over: A case study of ELT in Danish higher education
Elke Susanne Greifeneder 113

10 Flipped Learning in Organic Chemistry for Life Sciences – Experiences and Considerations
Kenneth T. Kongstad 125

Part III Stimulating student activity and deep learning

11 Stimulation of deep learning and active participation of students during long and context rich lectures
Karla Kristine Freude 137

12 Innovation processes as a method to facilitate deep-learning?
Peter Nejsum 147

13 Determining the Effect of TLAs on Student Engagement, Activity, and Understanding in a Repeated Teaching Setting
Toine Bogers 157

14 Student-activation during lectures as a *Process* to elucidate the *Presage* of students and facilitate the learning *Product*
Henrik Hjarvard De Fine Licht 173

15 Utilizing case-work for inducing reflective thinking and interpretation skills
Pai Pedas 183

16 Increasing Social Integration in an Interdisciplinary MA Programme through Group Work
Jakob Elming 193

17 Challenges associated with teaching interdisciplinary courses - Getting the level right and increasing student's active participation in classes
Thilde Bech Bruun 201

18 Promoting Active Participation in Computer Science Lectures
Stefan Sommer 209

19 Improving teaching activities in a classical journal club session - Activation and involvement of a larger number of students
Lisbeth Rosager Poulsen 223

Part IV Supervision and supervision styles

20 How to improve your supervisory skills
Jacob Andersen 235

Part V Peer teaching and Peer assessment

21 Anvendelse af peer-feedback i kurset "Idræt, Individ og Samfund"
Charlotte Østergaard og Glen Nielsen 245

22 Testing and evaluating peer assessment of chemistry exercises
Martin P. Anderson 261

23 Peer evaluation - a teaching element increasing the formative evaluation of the students
Håkan Torbern Tagesson 271

24 Different forms of assessment for transferring students' ownership of learning assessment and developing their skills
Thai Thi Minh 281

Part VI Course structure analysis - constructive alignment

25 Using online quizzes for active learning and constructive alignment in a blended learning setting
Linda Udby 293

26 Constructive alignment analysis and redesign of the Ph.D. course 'Innovation and intellectual property rights in biotechnology'
Anders Bach 321

27 Implementation and evaluation of longer (> 3 hours) collaborative and case-based interactive learning exercises
Anton Stahl Olafsson 335

Part VII Students' perceptions of teaching environment and implications for teaching

28 Intended Learning outcome and course descriptions from a student's point of view – How are they perceived by the students?
Christoph Crocoll 345

29 The theory Y climate applied: Student driven lectures and how a high degree of student freedom can positively influence

both teacher and student satisfaction in terms of learning outcomes in a typical human geography course
Sarah Ann Lise D'haen 353

Global bibliography 376

Preface

Lars Ulriksen

Department of Science Education, University of Copenhagen

This volume of the series *Improving University Science Teaching and Learning – Pedagogical Projects* presents papers from participants who completed 'Adjunktpædagogikum' – the Teaching and Learning in Higher Education Programme offered by Department of Science Education in 2014. Like the previous volumes in the series, the papers offer a variety of examples of development of courses and teaching at the University of Copenhagen (UCPH) – mainly in the science or health related programmes, but this volume also has examples from two bachelor's programmes in the humanities. The purpose of publishing these papers is twofold:

- The papers may serve as inspiration for teachers and planners at UCPH as well as at other higher-education institutions in the development of the programmes offered there. The papers not only offer ideas for other teachers in the same field of study, but some of the experiences from trying out different teaching methods in, for instance, geography or from adjusting the teaching to the diverse backgrounds of participating students in, say, a course of tropical crop production can also be used to inform the reflections and developments of courses and teaching in other programmes and disciplines

- The papers document the range of development and experiments carried out by young teachers across a number of different programmes at UCPH. This bears witness to the commitment that many of these teachers put into their teaching and learning activities, but it also reveals some of the areas where there is a need to scrutinise, reflect on and change the teaching and the design of programmes at the university

The papers are written as the final assignment at the ‘Adjunktpædagogikum’. In this assignment the participants select a problem or challenge they are facing in their own practice as teachers and which they consider particularly relevant for them to look more deeply into. Therefore, looking across the papers it is possible to get an idea of the range and variety of challenges that programmes, students and teachers experience and the range of different initiatives that could be taken to meet some of these challenges. The volumes in this series therefore both offers insights into the challenges of teaching and learning at UCPH and into what teachers consider viable solutions to these challenges.

The papers echo some of the topics that are in focus in a number of projects launched by UCPH as a part of the 2016-initiative and by the centres for the development of teaching and learning at the different faculties (KUUPI – **K**øbenhavns **U**niversitets **U**niversitetspædagogiske **I**ndsats). This volume provides examples within some of the same topics. For instance, the papers by Elming (no. 16) and Bruun (no. 17) address teaching and learning in an interdisciplinary learning environment, while the paper by Greifender (no. 9) explores the students’ experiences of being in classroom where English is used as a medium of instruction. The paper by Axelsen (no.2) presents an example of the use of computer-supported learning. Also, a couple of papers present examples of different feedback formats which is another focus area for the development of teaching and learning quality at UCPH (the papers in part IV by Østergaard & Nielsen (no. 21), Anderson (no. 22), Tagesson (no. 23) and Minh (no. 24)).

This volume presents a range of different ideas and experiments that vary in scope and focus. Some contributions discuss changes of entire programmes while others experiment with aspects or parts of courses or particular activities. Experiences from previous years of running this course and of the outcomes of the participants’ final projects that are the basis for the papers presented in this series tell us that the impact on the programmes and departments where the participants do their teaching and research is rather diverse. While some of the ideas and experiences presented in the final projects and the papers reporting from it are embraced by heads of studies and by colleagues and have had a fairly direct impact on the design of or activities at the home programme, other participants have experienced a less enthusiastic reception of the ideas.

Presenting the papers in this series therefore also serve the purpose of making the ideas and experiences available to a broader public than only colleagues in the home department, at the programme or at the module. As such, this volume – as mentioned in an introduction to a previous volume – is a concrete example of one aspect of what is called ‘Scholarship of Teaching and Learning’.

The papers are organised in seven sections according to similarities in the themes of the papers. However, as indicated above there are also themes to be followed across the sections. We therefore encourage the reader to look into the themes of interest, but also to browse the papers for ideas and inspiration. The volume is a quarry of ideas for the development of teaching and learning at university.

Part I

Planning, designing or redesigning units, courses or programmes

1

Implementering af forelæsninger som hjælp til laboratorieøvelse på første års kemikursus

Christian Bukh

Institut for Plante- og Miljøvidenskab, Københavns Universitet

Introduktion

Denne rapport er afslutningen på KNUD projektet, der er en del af Universitetspædagogikum ved Københavns Universitet 2013-14. Brugen af laboratorieøvelser som en del af kemiundervisningen på universitetet har været en integreret del af undervisningen siden begyndelsen af 1800-tallet (Elliott et al. 2008). Rapport beskriver mine tanker og erfaringer under og efter opbygningen og implementeringen af ”labforelæsninger” som en støtte forud for laboratorieøvelser på et første års kemikursus. Dette er gjort for at fremme de studerendes udbytte af tiden de bruger i laboratoriet. Laboratorieøvelser som en del af et kursus er tungt både undervisningsmæssigt men også økonomisk. Derfor er det nødvendigt at se på om skrukturen af laboratorieøvelserne kan optimeres således det faglige udbyttet (kemisk forståelse) blandt de studerende kan øges - og som en sekundær ting om flere kan bestå eksamen via den øgede forståelse for faget.

Baggrund

Kursusbeskrivelse

Kurset “Kemi for Husdyrvidenskab, Miljøøkonomi og Naturforvaltning” (herefter kaldet ’Kemi HMN’) bliver udbudt ved Institut for Plante og Miljøvidenskab på Det Natur- og Biovidenskabelige Fakultet, Københavns

Universitet. Kurset ligger på 1. år som et obligatorisk fag for bacheloruddannelserne i henholdsvis Husdyrvidenskab og Naturressource. Kurset forudsætter kompetencer svarende til studentereksamen med kemi på B-niveau. Hovedtrækkene af kursets pensum gennemgås i forelæsninger som forudsætter hjemmeforberedelse og suppleres med teoretiske øvelser med opgaveregning. En lille del af opgaverne er obligatoriske hjemmeopgaver, som skal godkendes. Laboratorieundervisningen er obligatorisk og omfatter hjemmeforberedelse, gennemførelse af de praktiske øvelser og rapportering i fortrykte rapportskemaer (3-personers hold). Der var tilmeldt ca. 95 studerende til kurset i 2014 og alle var første års studerende fra de tre studieretninger Husdyrvidenskab, Miljøøkonomi og Naturforvaltning samt enkelte fra Geografi.

Laboratorieøvelserne forløber enten mandag eftermiddag, tirsdag eller onsdag formiddag med cirka en tredjedel af de studerende pr gang – se skema 1.1. Torsdag er den undervisningstunge dag for de studerende (og underviserne). Som et tilbud er der torsdag morgen åbent værksted, hvor de studerende kan få ad hoc hjælp til rapportskrivning. Efter rapportværksted følger forelæsning og teoretiske øvelser. Dagen afsluttes med en labforelæsning, som denne rapport omhandler. Forelæsningen omhandler den næstfølgende uges laboratorieøvelse. I det følgende kaldes denne forelæsning der omhandler den kommende uges laboratorieøvelse for labforelæsning for ikke at blande det sammen med de egentlige forelæsninger der afholdes af den kursusansvarlige torsdag formiddag. Min del af undervisningen har i 2014 været laboratorieøvelser mandag og tirsdag (totalt 75 studerende), rapportværksted og labforelæsningen torsdag.

	Mandag	**Tirsdag**	**Onsdag**	**Torsdag**
8-10		Laboratorieøvelse (h2)	Laboratorieøvelse (h3)	(8.30) Rapportværksted
10-12				Forelæsning
13-15	Laboratorieøvelse (h1)			Teoretiske øvelser
15-17				Labforelæsning

Tabel 1.1. Oversigt over ugen for Kemi HMN.

Målbeskrivelser, Faglige forudsætninger og Kompetencer[1]

Kursets laboratoriedel skal give et praktisk, personligt oplevet kendskab til kemi med relevans for biologi og miljø (nitrogen og fosfors kemi, metalioners reaktivitet og kendetegn), og en introduktion til bioorganiske molekylers kompleksitet, opløselighed og reaktivitet. I de fem laboratorieøvelser indgår nitrogens kemi (Kjeldahl-analyse, ammonium-ionens syre-base egenskaber og kompleksdannelse med metalioner), fosfats kemi (analyse, fældning, bufferegenskaber), klassisk analytisk kemi (iodtalsbestemmelse for fedtstoffer), organisk stofidentifikation (opløselighed, oxiderbarhed, syre-base egenskaber) og metalioners kemi (komplekser, oxidation, fortolkning af farve). I de obligatoriske laboratorierapporter lægges desuden stor vægt på korrekt omgang med enheder og måleusikkerhed samt fornuftig tolkning af forsøgsresultater.

Efter at have gennemført kurset forventes den studerende at kunne:

- analysere et simpelt kemisk spørgsmål skrevet som tekst og omsætte det til en ligning eller lignende
- relatere viden om kemi til biologiske og miljøkemiske problemstillinger
- rapportere om databehandling og fortolkning for simple kemiske eksperimenter

Baggrund for ændringer i kurset

Grundlaget for ændringerne i kurset er mine erfaringer fra kurset sidste år. Antallet af studerende sidste år var 75; også fordelt over tre øvelsesdage. Efter kurset kunne jeg se at jeg havde brugt meget tid i laboratoriet på at gennemgå dagens vejledning sammen med de studerende både før øvelsen og efter øvelsen for at øge udbyttet af både det praktiske og det teoretiske som øvelsen skulle underbygge. Gennemgangen af stoffet foregik på en lille tavle, hvor de studerende dels skulle stå op og dels havde mindre gode forhold til at se tavlen og tage noter. En anden uheldig ting jeg observerede var at de studerende blev trætte (sløve) af disse længere 'forelæsninger' og dermed tabte de moment igennem øvelsen. For mit eget vedkommende var det ikke optimalt at jeg kom til at give den samme 'forelæsning' hver dag (i tre dage) og ofte var det nødvendigt at gennemgå beregningseksemplerne flere gange idet øvelsen foregik i to laboratorier på en gang. Dette er baggrunden for dette forsøg på optimering af tidsforbruget i laboratoriet

[1] Taget fra kursusbeskrivelsen for Kemi HMN 2013/14

for mit vedkommende og et forsøg på at skabe en bedre læringssituation for de studerende. Som jeg ser det skal de studerende i laboratoriet lave 'våd' kemi og ikke lave teoretiske beregninger (ala TØ) og have forelæsninger. Håbet er at få flyttet specielt forelæsningsdelen ud af laboratoriet og til dels beregningerne og i stedet lave kemi i laboratoriet og få understøttet den teoretiske viden med eksperimenter. Evnen til at følge en vejledning, at observere og rapportere, og at præsentere data er blot nogle af de emner som Wood (Wood 1996) listede som værende blandt de primære mål med til at have laboratorieøvelser. Endvidere tilføjer (Reid & Shah 2007) yderligere gevinster ved laboratorieøvelserne såsom teamwork, planlægning af arbejde samt ikke mindst at øvelser er en oplagt mulighed for at vise de studerende hvad kemi er i virkeligheden og belyse teorien. En sidste ting er det praktiske i at kunne arbejde i et laboratorie – og dette er naturligvis ikke kun gældende for kemiske fag hvorfor kemi på første år kan betragtes som "en sandkasse" for de kurser der kommer efter, såsom Biokemi og molekylær biologi, hvilket også handler om at følge en vejledning, rapportere data og observationer.

Teoretiske overvejelser

Selvom de studerende får udleveret øvelsesvejledning i god tid og på det kraftigste opfordres til at læse den igennem inden øvelsen, viser erfaringen at størsteparten af de studerende ikke får nok ud af dette arbejde da de ikke har de eksperimentelle forudsætninger for at forstå vejledningens beskrivelse af tid og rum igennem øvelsen. Mit håb er at en dialogbaseret forelæsning kan være en mulighed for at gennemgå den kommende uges øvelse og derved øge de studerendes udbytte i form af bedre observationer og dermed bedre indsigt i de reaktioner, der sker i forsøget. Dele af de fem laboratorieøvelser er placeret før forelæsningen i emnet, dette har været nødvendigt for at få skemaet til at gå op. Resultatet af dette er ofte at en stor del af de studerende ikke er klar over hvorfor de egentlig skal lave den pågældende øvelse (hvad skal den enkelte deløvelse underbygge fra lærebogen?) og ligeså hvad skal de holde øje med mens de laver øvelsen? De studerende vil ikke have den fornødne viden til at observere og lære af øvelserne (Johnstone & Al-Shuaili 2001). Dette var bl.a. grunden til 'forelæsningerne' sidste år. Labforelæsningerne skal give en kort begrundelse hvorfor vi skal igennem de enkelte øvelser og på den måde opbygge et fælles udgangspunkt og dermed danne grobund for diskussioner af øvelserne i laboratoriet. Et af de store problemer med læring i laboratoriet er at det af uden en teoretisk viden er det meget svært at få noget ud af øvelserne. De studerende vil ikke have den fornødne viden til at observere og lære af øvelserne hvis de ikke har teorien på plads (Johnstone & Al-Shuaili 2001).

Som det er beskrevet i kursusbeskrivelsen er det forventelig at de studerende efter kurset bl.a. skal rapportere om databehandling og fortolke simple reaktioner. Et af de store problemer ved laboratorieøvelserne på første år af studiet er manglende håndværksmæssige evner både i håndteringen af kemikalier men også i håndteringen af udstyr. De studerende er ofte meget dårligt klædt på til at gennemføre et kursus, da det enten er længe siden de har haft kemi eller fordi de har haft så lidt praktisk kemi i gymnasiet. Resultatet er dermed at de studerende bruger deres opmærksomhed på at finde det rigtige glas, finde de rigtige flasker, håndtere udstyr eller indstille apparater og dermed ikke har overskud til at følge med i reaktionerne, som det ellers var tiltænkt.

En af de ting jeg har gjort meget ud af i forelæsningerne er at klæde de studerende på til at kunne observere de rigtige ting mere end blot se dem (Young 1979). Kempa og Ward har beskrevet hvorledes studerende ikke lægger mærke til en ud af tre observationer de gør i laboratoriet. Dermed sagt ser de studerende på forsøgene som det var tiltænkt men de observere (lægger mærke til og husker) ikke en ret væsentlig del af det der var tiltænkt ved forsøget (Kempa & Ward 1988). I dette kursus kunne det være at de ikke ser at der dannes et bundfald og at dette hurtigt efter går i opløsning igen for eksempel grundet koblede ligevægte. Dermed får de ikke muligheden for at underbygge teorien med praktiske forsøg. De studerende har haft øjnene på glasset konstant men de var ikke klar over at det gik stærkt og at tilsætning af reagens B skulle ske laaaangsomt eller at der f.eks. var koncentrationsafhængighed ved forsøget. Den kognitive evne at observere opbygges og udbygges gennem livet og det jeg har forsøgt ved forelæsningerne er ikke blot at fortælle de studerende at de skal observere hvad der sker men også at vise dem hvor, hvornår og hvordan disse observationer kan gøres. Dette gjorde jeg ved at bruge billeder af reaktionen/apparatet taget under sidste års kursus. Tanken var at de studerende ville være i stand til at observere reaktionen og ikke blot se noget skifte farve (og dermed overse dannelse af bundfald, bobler mm) hvis de havde set opstillingen på et billede. Det er et forsøg på at vise vejen for de studerende med enkelte eksempler med håb om at det vil motivere dem til at arbejde videre med det i tiden der er mellem denne forelæsning og laboratorieøvelsen. Jævnfør skemaet hvor labforelæsningen er lagt i ugen før øvelsen foregår og i umiddelbart forlængelse af denne uges øvelse (udarbejdelsen af rapporten fra 'denne' uges øvelse er netop afsluttet til morgen i 'Værkstedet') har de studerende sjældent fundet vejledningen frem og skimmet den igennem.

Metode

Ændringer af kurset

Forelæsninger: I det følgende kaldet labforelæsninger for at holde dem afskilt fra de egentlige forelæsninger, som afholdes af den kursusansvarlige. Dette er det nye tiltag i kurset og holdes i ugen før de enkelte laboratorieøvelser.

Prelab: I kurset 2013 havde jeg startet på at lave prelab spørgsmål. Prelab spørgsmål var en del af spørgsmålene fra rapportskema som ville være hensigtsmæssigt at have lavet inden øvelsen påbegyndes. Det kunne være beregninger på hvor meget af et stof der skulle afvejes for at lave en opløsning eller kontrolspørgsmål således de studerende var 'tvunget' til at læse vejledningen igennem inden øvelsens begyndelse. Denne del optimerede jeg på ud fra erfaringerne fra 2013. Dette arbejde nævnes ikke videre i denne rapport.

Laboratoriet: Øvelsesvejledningen blev optimeret fra sidste år for at reducere antallet af knudepunkter i vejledningen hvor de studerende kunne misforstå budskabet eller enkelte dele af vejledningen blev strammet op for at få klarhed og trække budskabet klarere op. Dette omtales ikke videre i denne rapport. Den praktiske del af laboratorieundervisningen blev omstruktureret fra kurset 2013 idet jeg kun gav korte indledende forklaringer, og kun i det tilfælde det var strengt nødvendig før de studerende blev sluppet løs i laboratoriet. Dette gjorde jeg i stedet for at vente på at de sidste studerende skulle dukke op (dette kan hurtigt tage både 10-15 minutter!) og derefter bruge 10-15 minutter til gennemgang af vejledning lod jeg det være op til de studerende at være forberedt.

Evaluering af ændringerne

For at evaluere på ændringerne fra 2013 til 2014 brugte jeg dels fire spørgsmål til den sidste af de fem forelæsninger samt den lidt mere empiriske 'stik-fingeren-i-jorden' ved øvelserne og ved gennemgang af rapporterne.

Evalueringen var ment som en 'blød' evaluering og ikke ment som en statistisk evaluering. Det var der ganske enkelt ikke ressourcer til.

Resultat

Evalueringen af laboratorie-forelæsningerne er delt op i tre dele: Forelæsningerne, Øvelserne og Rapporterne.

Længden af forelæsningerne var fra starten planlægt til 2 lektioner af 30 min med en pause imellem. Det viste sig at være for optimistisk fra min side. De studerende var ikke i stand til at holde opmærksomheden så længe sidst på dagen, hvorfor jeg ændrede det til en lektion af ca 40 minutters varighed uden pause. Af de ca 95 der var tilmeldt kurset var der i gennemsnit mellem 45-50 deltagere til labforelæsningerne. Dette var lidt færre end der var til en normal forelæsningen eller til de teoretiske øvelser i timerne op til. En afsluttende clicker-spørgeskemaundersøgelse viste at af de 45 der var til sidste forelæsning havde 79% været til mindst fire af forelæsningerne. Umiddelbart tilfredsstillende i forhold til at det var sidst på en lang dag. En mundtlig snak med de studerende i laboratoriet om hvorfor de ikke havde deltaget var, at studiejobs og lign. måtte prioriteres samt at de havde lavet deres teoretiske opgaver og ikke ønskede at vente på labforelæsningen en time senere. Sammensætningen imellem teori og forklaringer under forelæsningerne blev revideret i løbet af kurset. Tiden blev dels reduceret og jeg fandt ved diskussion med de studerende i laboratoriet ud af hvad de fik mest ud af at blive gjort opmærksom på ved forelæsningen. Billederne var tydeligvis den bedste hjælp således de vidste hvad de skulle se efter. Omkring det faglige udbytte var 67% af de studerende af den opfattelse af de stod bedre fagligt rustet til øvelserne efter forelæsningen og 64% havde haft fagligt udbytte af forelæsningerne generelt (se Appendix A).

Ved kursusstart havde jeg en ide om at de studerende skulle hente slides fra forelæsningerne og bruge dem til at læse op sammen med vejledningen. At dømme ud fra clicker-spørgsmålene har dette ikke været en udpræget succes. Kun 41% kunne bruge slides fra forelæsningen med fordel under forberedelsen til øvelsen. Under øvelserne kom der dog ofte spørgsmål som en gennemlæsning af forelæsningsslides inden øvelsen ville kunne havde svaret på, så jeg vil tillade mig at være afventende og gøre det samme næste år.

Under selve øvelsen var det min plan at de studerende skulle opfordres til at være selvstændige frem for at jeg "curlede" dem ind i laboratoriet.

Derfor startede øvelserne til tiden og de studerende kunne påbegynde øvelsen uden at vente på deres medstuderende og ikke mindst min enetale. Det fungerede rigtig fint og det var tydelig at der fra de enkelte grupper altid havde været mindst en deltager til labforelæsningen og dermed var de klar til at starte op. Spørgsmålene igennem øvelsen til den teoretiske del var der stadig og dette finder jeg forståeligt. Til forelæsningen kunne jeg kun give en meget overfladisk forklaring på teorien efter aftale med den kursusansvarlige, der også havde forelæsningerne. Dette kunne jeg mærke i specielt de uger hvor teorien ikke var gennemgået inden øvelsen. Hvordan dette kan gøres bedre er et godt spørgsmål. Det vil kræve meget forud læsning for de studerende og det vil kun være et fåtal af de studerende der vil have overskud til dette må jeg erkende.

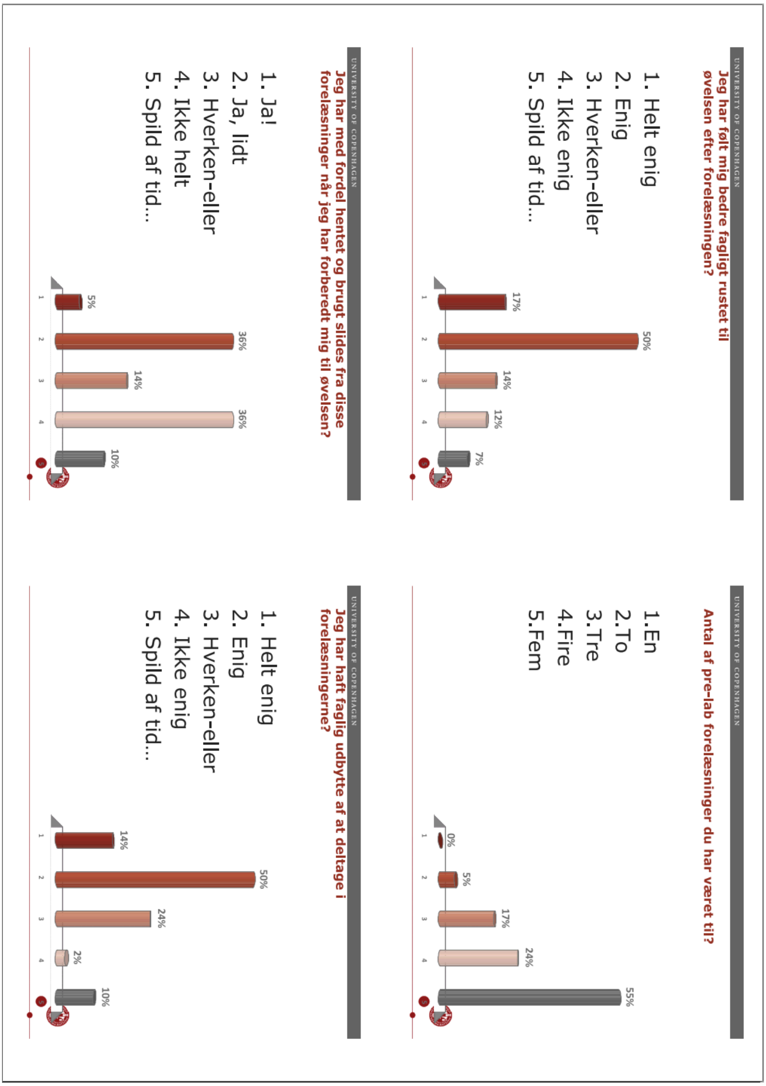
Kvaliteten af rapporterne var umiddelbart bedre end det var tilfældet sidste år. Dette er bedømt ud fra antallet af genafleveringer. Her skal det dog siges at der er mange faktorer, der spiller ind; bla. hjælp ved værksted, hjælp fra medstuderende, hjælp i laboratoriet og dermed udgør forelæsningen kun en lille del af det organ hvor de studerende kan have opbygget viden til at besvare rapporten tilfredsstillende.

Det indsamlede datamaterialet som skulle hjælpe med evalueringen af labforelæsningen var meget spinkelt og spørgsmålene, kan jeg se nu, var ikke tilstrækkeligt dækkende. De studerende skulle have haft spørgsmålene til den rigtige forelæsning for at få flere til at svare på dem og dermed også de studerende, der havde valgt ikke at følge labforelæsningerne. Det vil jeg gøre næste år.

Konklusion

Umiddelbart vil jeg mene at forelæsning inden en laboratorieøvelse er en god ting. Det har ikke været muligt at samkøre eksamensresultaterne med resultaterne laboratorieøvelserne på grund af anonym eksamen. Der er dog en række faktorer der skal være på plads for at udbyttet øges. Hvis stoffet, der skal danne forståelsesmæssigt grundlag for øvelsen, ikke er gennemgået til forelæsningen/teoretiske øvelse endnu, er det meget krævende at gennemgå og klæde de studerende på ved en labforelæsning hvis den skal være kort. Sagt med andre ord er det teoretiske fundament ikke på plads er det yderst svært at bygge bro til de studerende. Noget praktisk er placeringen af labforelæsningen. At den placeres på yderste mandat efter en hel dags kemiundervisning gør ikke indlæring lettere. Trætte studerende. Men dette er jo desværre et af onderne ved den blokstruktur, der blev indført for år tilbage hvor man har en hel dag med samme fag. Omkring optimering af øvelserne er det en fortløbende proces, der vil altid være noget der kan gøres bedre. Dette er en del af det interessante fra år til år. Hvad der i 2013 var ’klart’ i vejledningen og ikke gav anledning til de store misforståelser kan året efter resulterer i flere misforståelser og problemer i laboratoriet. Ikke to årgange (eller hold) af studerende er ens (heldigvis!).

A (der var 46 besvarelser)



2

Use of a proof assistant as a learning tool in an introductory logic course for computer science undergraduates

Holger Bock Axelsen

Department of Computer Science, University of Copenhagen

Introduction

The present report documents a teaching experiment undertaken in an introductory logics course for computer science undergraduates, where I introduced an interactive computer program, a so-called *proof assistant*, as a tool for learning.

As part of a larger revision effort to improve on low student retention and moderate pass rates in the course, I allowed the students to use the *ProofWeb*[1] proof assistant for their solutions of exercises in formal deduction proofs. In the exam, student performance in this area improved considerably compared to prior years, and also in comparison to students who did not use of the proof assistant. However, feedback on the student experience suggest that this improvement comes at the cost of a somewhat steep learning curve and increased workload. A few students even reported that they found the proof assistant to be a hindrance to understanding the formal systems it was intended help with. Still, most students ultimately found the tool useful and adopted its use. Even though it is difficult to separate this from the other revision instruments, the results suggest that a proof assistant is effective as a learning tool in this course, but that it needs to be supported by additional teaching and learning activities to improve efficiency.

[1] An online version of ProofWeb is available at http://prover.cs.ru.nl.

Background

Course information

"Logik i datalogi" (Engl. Logic in Computer Science, abbrv. LiCS) is an elective 7.5 ECTS advanced undergraduate course at the Department of Computer Science at the University of Copenhagen. LiCS is offered once a year in block 1 (early autumn), introduces the students to formal logics of various kinds, and develops this in directions generally interesting to computer scientists, i.e. decision procedures, algorithms, data structures, and model checking for the verification of software, cf. the course description[2]. The 60 students who enrolled in the course in 2013 were overwhelmingly 3rd year Bachelor's students with the department.

The students are required to submit homework sets for 6 weeks running, and 5 of these have to be approved (by teaching assistants) to qualify for the exam. The course has historically suffered from low retention and moderate pass rates: from 2008 through 2012, about 55% of the enrolled students have qualified for and attended the exam, and of these about 70% passed[3]. This gives an aggregate of less than 40% of the enrolled students who end up passing[4]. In course evaluations students consistently report that they find the academic level and work load of the course high.

I became course responsible in early 2012, and have taught the subsequent two editions of the course. In an internal evaluation of the 2012 course run I identified a number of problem points in the course structure that may have contributed to student dropout and exam failure rates. For the 2013 edition of the course I therefore instigated a number of changes to realign the course elements, in keeping with the principles of constructive alignment (Biggs & Tang 2011), while keeping the syllabus and intended learning outcomes essentially unchanged.

To keep this report reasonable in scope, I shall focus on one particular aspect of the revision effort, namely the use of the ProofWeb proof assistant as a learning tool. The most notable of the remaining revisions are structural: a different exam format (a 27h take-home assignment rather than a 4h sit-in exam), and the use of exercise classes (mostly lab work) to supplement the lecture-based teaching sessions.

---

[2] Available at http://kurser.ku.dk/course/ndab05005u/2013-2014.

[3] In 2008 the course adopted the structure kept up to and including the 2012 edition with respect to exam format and qualification requirements.

[4] Not including reexams, as this data was not readily available.

Problem Statement

A particular recurring problem not directly addressed by the mentioned structural changes is the abilities of the students in constructing *formal proofs*. A major part of the first half of the course is devoted to the *natural deduction* system for constructing such proofs. The students are expected to achieve proficiency in deriving natural deduction proofs, as partial demonstration of the following intended learning outcomes (ILOs) of the course (English translation mine):

- *Knowledge of:* the definition of logics in terms of syntax, semantics, and natural deduction systems, and of how one formally reasons about logical formulas.

- *Skills in:* deciding and proving formal properties of logical formulas (e.g. satisfiability, validity, implication and equivalence) both using semantic arguments, and by natural deduction.

Formal deductions play a key role in LiCS. The idea of a formal proof is the very first novel concept introduced to the students in the course, and much of the first half of the course directly builds on the students' understanding of natural deduction and how it is used to construct proofs.

Previous teacher course evaluations and student performance in previous exams suggest that such proficiency may serve a 'gate keeper' function in the course. A student that fails to demonstrate reasonable proficiency with natural deduction in the exam will likely also fail to demonstrate adequate achievement of the other course ILOs, and is thus likely to fail.

Thus, although formal proofs only make up a limited part of a typical LiCS exam set (about 10–20%), an experimental effort aimed at early widespread achievement of this learning goal appeared reasonable. The hoped-for effect is that achieving this proficiency early 'leaks' into achieving other ILOs, and that this in turn would improve retention and exam performance. For the 2013 edition of the course, I therefore chose to allow the students to use ProofWeb to solve exercises in constructing natural deduction proofs. The didactical underpinnings for this is explored below, but the informal reasoning is this: a proof assistant can error check a given formal proof reliably, instantly, and while the student builds the proof.

This leads to the following problem statement: *Is the ProofWeb proof assistant an effective and efficient tool for learning in LiCS?*

Theoretical considerations

Problem analysis.
Prior to the revision, the course supported achieving proficiency with formal proofs only to a weaker extent. The required training was 3 relegated almost exclusively to the weekly homework sets, i.e., to learning activities with assessment. This appears to be a failure point[5].

Although intended as formative, the homework sets in LiCS serve a summative assessment purpose also, in that qualifying for the exam requires 5 of 6 sets are approved. This kind of setup has been linked to students ignoring the formative aspects and focussing exclusively on the summative aspects (Gibbs & Simpson 2004). Although this may well be in effect in LiCS, it is likely not the only effect in play. In fact, it appears that for the low-achieving learners the ILO in question is probably not well served by the existing assessment format at all, in particular with respect to feedback[6].

To understand why, one first needs to appreciate the unforgiving nature of formal logic. One does not aim for merely ‘morally’ correct proofs, but absolutely correct ones: a formal logic proof is always unambiguously correct or not, and even subjectively tiny errors technically invalidate the entire proof. Now, for the average LiCS student this course is their first encounter with formal logic, and they are furthermore usually not proficient in the considerably more lax notion of an ordinary mathematical proof. This means that constructing a formal proof is (certainly initially) a *difficult* task for them, and that they have low confidence in their hand-generated solutions. Multiple revision cycles of hand-written proofs are usually necessary to get *everything* right, and the students are strongly reliant on feedback for this.

Formative feedback is an incredibly complex issue with much conflicting research. However, some trends can be identified at the task level, *cf.* the review article by (Shute 2008), which I have used as a framework (and useful reference list) for the theoretical analysis.

For the kind of task at hand, the existing literature, in guise of the handy guidelines in (Shute 2008, Tables 3-5), suggests that the feedback format

[5] One response to the problems with achieving proficiency with formal proofs has been to increase the number of deduction exercises in the homework sets, which has not been particularly effective.

[6] For this reason the revision effort also included the design of new teaching and learning activities (TLAs) to support this ILO, but describing them in detail is beyond the scope of this report.

employed in LiCS is flawed: For *difficult* tasks, the feedback should (at least initially) be *immediate*, as it should for *low-achieving learners* in general. But, the course structure does not allow for this: only one revision of a homework set is usually possible, and feedback is *delayed*, not immediate. Furthermore, feedback for these exercises is usually mildly elaborated error flagging (of *low-to-mid complexity*), but presented *in bulk* for all errors identified in a given proof, rather than in *manageable units*. An additional problem in this context is that much of such bulk feedback may even be irrelevant to obtaining a correct solution to a particular exercise, as it can pertain to a line of reasoning which will no longer be visited if an earlier error is corrected.

These properties of the formative feedback as hitherto offered may all impede learning, or serve to promote surface learning over deep learning.

How a proof assistant can help

Luckily, there is help to be had: formal systems are sufficiently rigid and mechanical that errors in formal proofs can be identified purely syntactically, something which computers are especially good at. The use of computers to assist with and verify mathematical proofs is an old idea, going at least as far back as the AUTOMATH programming language in the 1960's. Tools of this kind have long been used in the teaching of formal logic, and a bewildering array are available. These range from very minimalistic non-interactive proof checkers to elaborate highly interactive e-tutor systems. For a more elaborate explanation of which kind of tools are available, see (Huertas 2011).

Among the diversity of tools are so-called *proof assistants*. A proof assistant is an interactive computer program for building and mechanically verifying mathematical proofs. In particular, proof assistants provide (corrective) feedback *while* constructing a proof, rather than 'just' checking an already completed proof. It does so (usually) via error messages explaining why a particular line in the proof is unacceptable, and refuses to progress further until this is remedied. While this could be interpreted as *feedback intrusion*, which can impede learning (Kluger & DeNisi 1996), this type of restrictive *answer-until-correct* tutor control has also been linked to more efficient learning (Corbett & Anderson 2001).

In particular, a proof assistant is able to provide *manageable units* of *immediate, corrective* formative feedback, which has been linked to enhanced learning (especially for low-achieving learners) in computer-based instruction, *cf*. the review by (Mason & Bruning 2001). Proof assistants also tick more of the right boxes from (Shute 2008, Tables 3-5): They provide *unbiased, objective* feedback with focus on the *task, not the learner*, and immediate feedback has been linked to *immediate gains* and *more efficient* learning, which is an intended effect. Finally, (Nipkow 2012) suggests that proof assistants provide 'gamification' of theorem proving, which should enhance student motivation.

The choice of weapon for LiCS was *ProofWeb*, developed at Radboud University in the Netherlands. This was a conscious choice to limit the *impeding* effects on learning that a proof assistant might have. For instance, there is the risk that students substitute learning the *tool* for the intended learning of the *logic*. This risk comes from the fact that the student interacts with the proof assistant via short lines of code (so-called *tactics*), and the proof assistant responds to these with either an error message or by updating the view of the proof state presented to the user. (Figure 2.1 shows the ProofWeb interface.) In contrast, a logic is 'just' a set of *rules*, out of which one can build proofs, and there may or may not be a close correspondence between interaction with the proof assistant and proofs in the logic. There is thus in general the possibility of attaining proficiency in one, without the other. However, ProofWeb was *explicitly* developed to support teaching the formal logics of the textbook used in LiCS, *cf.* (hendriks et al. 2010). In particular, the textbook proofs and ProofWeb's rendering of proofs are diagrammatically almost identical. Furthermore, there is a nearly one-to-one correspondence between ProofWeb tactics and the rules of the natural deduction system, in that each tactic explicitly specifies which rule and assumptions are used to justify each line in the diagrammatic proof.

A separate risk is that the inherent *answer-until-correct* format may lead the students to not only use the proof assistant for *scaffolding*, but actually *abuse the feedback* to brute-force their way to solutions, which would constitute surface learning (Aleven & Koedinger 2002). However, the facilitative aspect of ProofWeb's feedback does not appear strong enough for this (except in the case of extremely short proofs.) When accepting a tactic as correct, ProofWeb guarantees merely that this individual step corresponds to the legal use of a rule in the logic. However, there is no evaluation of, or feedback given on, whether this tactic is a viable way towards a complete proof: indeed, proof *strategy* requires, and has, its own additional TLAs in the course[7].

[7] ProofWeb use may help here as well, by pruning false strategies relying on erroneous rule use.

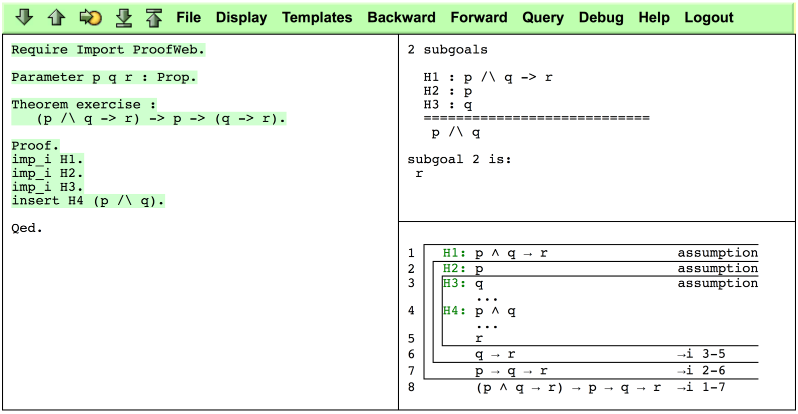


Fig. 2.1. The ProofWeb interface. The left window is where the student writes tactics; the upper right window is a representation of the proof state in terms of which things have to be proven (the subgoals), and under which hypotheses; and the lower right window shows a rendering of the proof so far, in the same format as the course textbook.

The above risks are predicated on the students becoming proficient with the tool, but this in itself is almost certainly hard: using a proof assistant effectively constitutes having to learn a new programming language (and so does learning a logic.) Students will very likely initially struggle with *both* the logic itself *and* with expressing it in ProofWeb. Although the student' *background* is expected to be helpful, as computer science students at the department are exposed to a variety of widely different programming languages through their programme, the risk of *cognitive overload* appears high in this context, and should be addressed in the implementation.

The conclusion is that although using a proof assistant is expected to enhance learning, it is not just a substitute for human assessment, and must be supported by teaching and learning activities to offset the complication overhead. As a final remark, we note that the use of a proof assistant serves to align the course more with the surrounding educational programme, which emphasizes the use of computers and computational methods in the programme learning outcomes[8].

[8] See the study programme at http://www.science.ku.dk/studerende/ studieordninger/bachelor/datalogi/Sto_datalogi_2009.pdf.

Methodology

Course modification

Incorporation of ProofWeb into the course was implemented as follows.

- *Exercise solutions:* From week 2 and onwards the students were given the option to submit either a hand-written proof or a proof made via ProofWeb (consisting of a proof script and a screenshot of the resulting proof) for their solutions to exercises demanding formal proofs. Note that ProofWeb use was not made mandatory. This policy was in effect both in the homework assignments and the exam.

- *Exercise classes:* 3 of the 4 hours of exercise classes in weeks 2 and 3 were used to introduce ProofWeb to the students and have them work with it in class, under supervision by the teachers and TAs.

- *Lectures:* In the first week of the course ProofWeb was *not* mentioned, to allow the student to familiarize themselves with the concepts of formal systems and natural deduction for propositional logic separately. In week 2, after introducing ProofWeb in the exercise classes, a follow-up 20 min. lecture on ProofWeb use was conducted. In week 3, in the lecture introducing the second major deduction system (predicate logic), the additional ProofWeb rules required for this were covered.

- *Course materials:* Supplementary notes on ProofWeb use were (somewhat hastily) produced by the teachers, following a number of students reporting that they found the official documentation confusing.

Data collection

To evaluate the effect and efficiency of using this proof assistant as a learning tool in LiCS, and of our teaching of it, I collected data from the following sources. Note that this data was collected with the intent of performing a soft analysis only, and that the implementation was not set up to facilitate statistical testing.

Exam solutions
The exam had 4 subquestions asking the students to do 6 formal deduction

proofs (approx. 15% weight of the total exam.) How many students reached the exam, and how many passed? What was the grade distribution? How did the students perform on the exam parts with formal deduction? How many students used ProofWeb, and did this correlate to performance in any way?

Questionnaire on ProofWeb

In the final (summary) lecture of the course students were asked to fill out a 20 min. questionnaire on their use and experiences with ProofWeb. This was done in class to maximize response. Students who did not attend this lecture were asked to fill out the questionnaire electronically. The questionnaire form (in Danish) is shown in Appendix A, and contains roughly four sections as follows.

- Demographics data, including prior exposure to logic and proof assistants. (Q1, Q28–Q30)
- Questions regarding the extent of the student's use of ProofWeb over the course period, self-evaluated proficiency, and current usage type. (Q2–Q5)
- Student experience measured by level of agreement with predefined statements on a scale from 1 to 5. Statements were formulated to provide insight into the students' *attitude* towards using ProofWeb, *practical experiences* with it, their *trust* in the system, whether they believe it *aided their understanding*, their experience of our *teaching* of the system, and quality of *documentation materials*.

  In the development of this part I attempted to emulate the 'Course Evaluation Questionnaire' (see (Wilson et al. 1997, Appendix, p. 53)) which has 8 a long history of development and validation (McInnis et al. 2001). Each statement is (hopefully) unambiguous and strong, and the statements are unsorted. This was done to limit the risk of misunderstanding, strengthen response interpretation, and to encourage focus and reflection on each individual statement from the students. (Q6–Q25)
- Student-formulated comments on the use of ProofWeb. By placing these questions *after* the multiple choice part above, I hoped to have forced them to already reflect on the many aspects involved in ProofWeb use. The late placement runs the risk of response fatigue, so to encourage response I asked for deliberately structured feedback (name 3 good

and 3 bad things, mark the 2 most important of these), as well as free-form comments. (Q26, Q27)

Course evaluation
Comments from the generic final course evaluation questionnaire. In addition to this, I had informal discussions with students runningly, although interviews were not formally conducted.

Results

Exam performance

42 out of 45 qualified students handed in solutions to the exam, which means that 75% of the 60 students enrolled at course beginning qualified for the exam. 80% of the qualified students passed, for an aggregate 60% pass rate for all enrolled students. With 3 abstentions, the pass rate rises to 86% for those who submitted a solution to the exam.

The students largely adopted the use of ProofWeb, with 76% using ProofWeb wholly or partially for their formal proofs in the exam solutions. 25 students used ProofWeb exclusively, 7 students used a mixture of both ProofWeb and handwritten proofs, and 10 students did not use ProofWeb at all and had only handwritten proofs. Figure 2.2 shows the grades (for the entire exam) distinguished by the type of solution to the formal deduction parts.

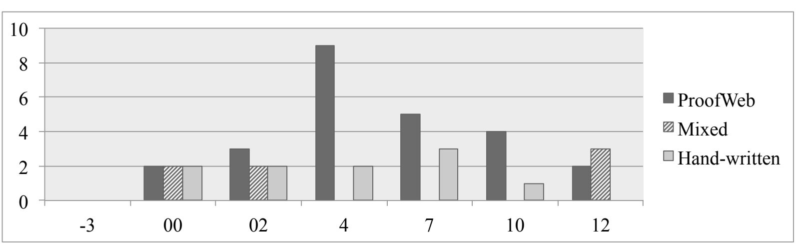


Fig. 2.2. Grades for the 2013 exam distinguished by ProofWeb use.

By their nature as verified proofs, submitting a ProofWeb script as a solution meant getting that question correct. (Of course, not all students submitted solutions to all exercises.) However, for those students who submitted at least some hand-written solutions performance was very diverse, the only constant being that no such student escaped making at least one formal error (however slight). In fact, the (subjective) performance on the formal proofs for these groups closely resemble the grade distribution: the students who did not use ProofWeb at all are fairly uniformly distributed (but taper off at the highest grades), and the mixed students are bimodal.

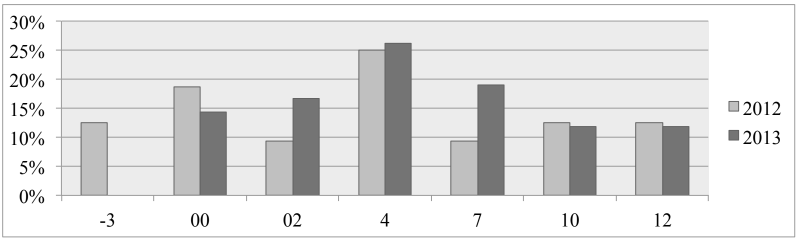


Fig. 2.3. Grade distributions for the 2012 and 2013 editions of the course

While the grade distribution in 2013 compared to 2012 version (see Figure 2.3) suggests that the course revision effort may have been successful in aiding a portion of the weaker students (who moved up the grade scale) the above suggests that adopting ProofWeb in this course run may not have had a strong impact on performance (although only one student managed to reach a high grade without using it.) However, another interpretation could be that a number of students use ProofWeb as scaffolding, and attain higher grades thereby, since these students generally performed better in the formal proofs than the students not using ProofWeb. Either way, the exam data does not appear strong enough for definitive conclusions regarding ProofWeb use. The only certainty is that both the student retention and pass rate rose markedly compared to previous years, and that performance in formal proofs improved considerably, supporting that ProofWeb was at least effective in supporting attainment of the ILOs in question.

For the failed students, we find one item of note: showing enough proficiency to demonstrate weak attainment of the ILOs in question does not entail passing the course. This is reasonable: that failure to achieve these ILOs implies failing the course does not entail that achieving these ILOs implies passing the course.

Questionnaires

I received 28 responses (17 on paper, 11 electronic) to the ProofWeb questionnaire.

The demographics held no surprises. The students were almost all 3rd year computer science undergraduates, with the exception of a few mathematics undergraduates. For all except a single student this was their first exposure to formal logic in a university course, and this single student was the only one to report prior experience with a proof assistant.

Slightly more interesting are the self-reported data on ProofWeb practice. The questionnaire data may all be slightly skewed towards the non-ProofWeb users, as these were represented in the questionnaire data to a greater extent than in the exam. As expected, current exclusive (or near-exclusive) ProofWeb use correlates with heavy use through the course, and with the level of self-reported proficiency. Interestingly, the *gamification* effect posited by (Nipkow 2012) does not appear not to hold true for LiCS: while students ended up largely adopting the system, there was no universal agreement (or even polarity of responses) as to whether it was fun, and only very few students ended up proving significantly more theorems in the system than required by the exercises and homework sets. This is counter to the expectation if gamification had been a significant effect.

Aggregate data for Q6–Q25 and Q26 is shown in Appendix B. The responses show a number of interesting points, not least that I made some design mistakes with the questionnaire: at least one student (and likely more) certainly swapped the polarity of the Likert scale in Q6–Q25. Additionally, by Q26 there is evidence of some response fatigue, in that many responses do not match the asked-for format. This is corroborated by the near complete lack of responses to the free-form comment asked for in Q27. Still, the student responses show the following trends.

- Very strong trust in the correctness of ProofWeb proofs (Q6), and only moderately strong trust in paper proofs (Q13).
- Very strong preference to working with the logics on paper before attempting them in ProofWeb (Q25). Moderately strong preference towards more teaching with ProofWeb, in particular exercise classes (Q11, Q12).
- A small preference to declaring ProofWeb use fun (Q10), but not enough to spark a general interest in proof assistants (Q14) or rework proofs for optimisation (Q16). A slightly stronger preference to perse-

vere when frustrated (Q9), although there was no strong trend of frustration (Q17).
- Weak documentation. Although students studied the material closely (Q21) they cannot rely on it for help (Q13).
- Bimodal response to verification of handwritten proofs (Q18), although the students do not believe that this often located errors (Q22).
- Strong preference for the use of a proof assistant in the course (Q23). This is particularly interesting since the students do not strongly believe it aids their understanding (Q8, Q24) or is faster to work with (Q20), even (mildly) disagreeing that it helps them understand the deduction rules (Q19).

These points were largely repeated in the responses to Q26, where the following trends can be seen:

- Strong appreciation of the (instant) verification and corrective aspects.
- Strong dissatisfaction with certain aspects of the ProofWeb interface, *in particular* the quality of the front-end and the error messages.
- Many students report that ProofWeb has a steep learning curve, and that the introduction to ProofWeb use was lacking.
- Appreciation of the systematic computer science approach to formal proofs offered by ProofWeb.
- Positive aspects were more frequently marked as important than *negative* aspects.

Finally, very few students remarked on ProofWeb in the generic course evaluation questionnaire, instead focussing on workload, in particular the the size of the homework assignments (which they, consistent with previous years, found too large and demanding.) Taken together, these responses suggest that students by and large accepted ProofWeb as an integral part of the course.

The general picture offered by the questionnaire responses corresponds to my impressions from informal discussions. Despite a number of misgivings, the students mostly appreciated the use of a proof assistant, and found it useful. However, workload remained high, suggesting that the efficiency bought by automating assessment of the proofs may have been (at least partially) subsumed by the added overhead it introduced. The interface problems and perceived low quality of the error messages are worrisome, as appropriate feedback was a central motivation for the introduction of a proof assistant in the first place. The reported steep learning curve is also alarming, as I aimed for early efficient gains by allowing a proof assistant.

Conclusion

Student performance in the exam with respect to formal proofs was good, especially for students who adopted the use of ProofWeb. Combined with the other revisions, the course saw a significant rise in retention and pass rates compared to previous years. However, many students were frustrated with the ProofWeb interface and documentation, and would additionally have liked a better introduction to the tool. Still, its adoption was widespread, and the students did appreciate the strengths of such a system (if not necessarily this one in particular.)

Although frustration is to be expected when learning a new tool, I agree that the teaching implementation can probably be significantly improved. In particular, rather than relying mostly on exercise classes, more lecture time should be devoted to the system. One possibility is to integrate ProofWeb more tightly in the introductory lectures. However, given that the students widely appreciated having worked with propositional logic before the use of ProofWeb, and reported that this went too quickly with predicate logic, separation is advisable. On the other hand, because mastering the tool in itself was not the primary objective, teaching a more *restricted* use of the tool than done for this experiment is also worth considering (and might avoid having to pushing other lecture content out.) For instance, one might teach its use as a proof checker for existing (hand-written) proofs *only*, by teaching a particular fixed methodology for converting hand-written proofs to ProofWeb scripts, and leave more sophisticated use up to the individual student. Then again, many students reported that the approach to proof building offered by the *interaction* with ProofWeb was positive, and a number even professed greater proving abilities *inside* ProofWeb than outside. In either case, particular care should be taken to ensure that the students understand and can act on the feedback that ProofWeb provides.

In answer to the problem statement, I believe that, yes, ProofWeb is *effective* as a learning tool for the Logic in Computer Science course, but that the *efficiency* with the current teaching implementation is more questionable. The investment on part of the students was considerably higher than I estimated it would be, making it less valuable for my purposes than expected. In spite of this, I believe that a proof assistant is a useful and relevant addition to the course. ProofWeb may work well in this role, given adequate teaching support to improve efficiency, but this requires additional and/or redesigned teaching and learning activities. Additionally, even though the intended learning outcomes were kept unchanged through this experiment, proof assistant use can be incorporated into future intended learning outcomes directly, strengthening the alignment between the intended learning outcomes of the course and those of the surrounding study programme.

A Questionnaire

The following 2 pages shows the paper version of the ProofWeb questionnaire. An electronic version was created as an electronic survey on Absalon (the digital course platform used by the University of Copenhagen.)

LiCS: Spørgeskema om ProofWeb

October 23, 2013

1. Udover ProofWeb, har du brugt en *proof assistant* før?: __________

   Hvis ja, hvilken, og hvordan: ____________________

2. På nuværende tidspunkt, hvordan bruger du ProofWeb når du skal løse en standard opgave i naturlig deduktion? (Vælg gerne flere svar.)

   - ☐ Kun på papir, bruger slet ikke ProofWeb
   - ☐ Først på papir, verificerer i ProofWeb bagefter
   - ☐ Først i ProofWeb, skriver ned i hånden bagefter
   - ☐ Kun i ProofWeb, skriver aldrig i hånden
   - ☐ Andet: ____________________

3. I løbet af kurset, hvor meget har du brugt ProofWeb?

   - ☐ Slet ikke
   - ☐ Kun det der blev lavet i øvelsestimerne
   - ☐ Et par gange
   - ☐ Ofte
   - ☐ Alle mine formelle beviser er lavet i ProofWeb
   - ☐ Andet: ____________________

4. Hvor mange af ProofWebs indbyggede øvelser har du lavet (ca.): __________

5. Beskriv dit eget niveau som ProofWeb bruger:

For hvert af de følgende udsagn, angiv i hvilken grad du er *enig* i udsagnet, hvor 1 = helt uenig, 5 = helt enig. Sæt ring om dit svar. (Skriv gerne kommentarer.)

6. Når jeg laver et formelt bevis i ProofWeb er jeg overbevist at det er korrekt.
   1 2 3 4 5
7. Jeg forstår fuldt ud hvad der sker når jeg angiver en ProofWeb taktik.
   1 2 3 4 5
8. Jeg forstår et formelt bevis bedre når jeg har lavet det i ProofWeb.
   1 2 3 4 5
9. Hvis ProofWeb ikke makker ret giver jeg ofte op og laver beviset i hånden.
   1 2 3 4 5
10. Det er sjovt at lave beviser i ProofWeb.
    1 2 3 4 5
11. Det var meget brugbart at se ProofWeb blive gennemgået i forelæsningerne.
    1 2 3 4 5
12. Der skulle have været færre øvelsestimer med ProofWeb.
    1 2 3 4 5
13. Når jeg laver et formelt bevis i hånden er jeg overbevist om at det er korrekt.
    1 2 3 4 5
14. Jeg er blevet interesseret i proof assistants efter at have brugt ProofWeb i kurset.
    1 2 3 4 5
15. Når jeg har problemer med ProofWeb kan jeg som regel finde en løsning i det udleverede materiale.
    1 2 3 4 5
16. Jeg optimerer aldrig mine beviser.
    1 2 3 4 5
17. Jeg bliver tit frustreret når jeg laver et bevis i ProofWeb.
    1 2 3 4 5
18. Jeg verificerer aldrig mine håndlavede beviser bagefter i ProofWeb.
    1 2 3 4 5

19. ProofWeb har hjulpet mig med at forstå hvordan deduktionreglerne virker.

    1 2 3 4 5

20. Det tager meget kortere tid at lave et bevis i ProofWeb end i hånden.

    1 2 3 4 5

21. Jeg har ikke studeret det udleverede materiale om ProofWeb særligt grundigt.

    1 2 3 4 5

22. Jeg finder ofte fejl i mine håndlavede beviser hvis jeg checker dem i ProofWeb.

    1 2 3 4 5

23. Jeg ville foretrække at der slet ikke var brugt en proof assistant i kurset.

    1 2 3 4 5

24. ProofWeb hjælper mig med at forstå hvis min bevis-idé er forkert.

    1 2 3 4 5

25. Det var rart at have arbejdet med deduktionsreglerne på papir før de blev introduceret i ProofWeb.

    1 2 3 4 5

26. Beskriv 3 dårlige, og 3 gode ting ved brugen af ProofWeb i kurset.
Af dine 6 punkter markér de 2 vigtigste med $*$:

Dårligt:	Godt:

27. Yderligere kommetarer til brugen af ProofWeb i kurset:

28. Du er:
- ☐ bachelorstuderende i: ____________________

  på __________ år.
- ☐ kandidatstuderende i: ____________________,

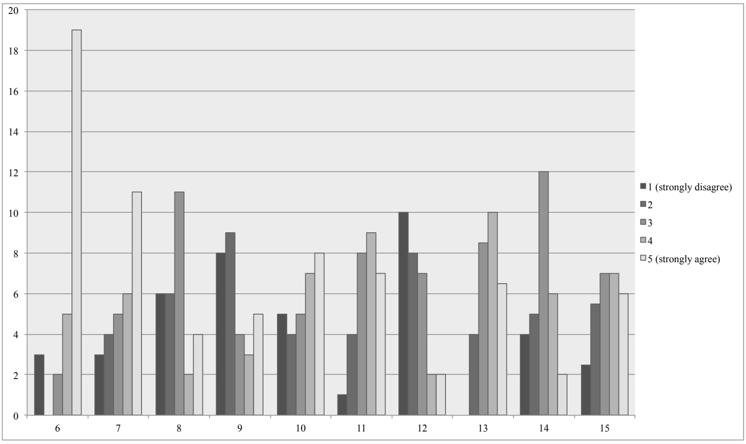
  og din bachelorgrad er i: ____________________

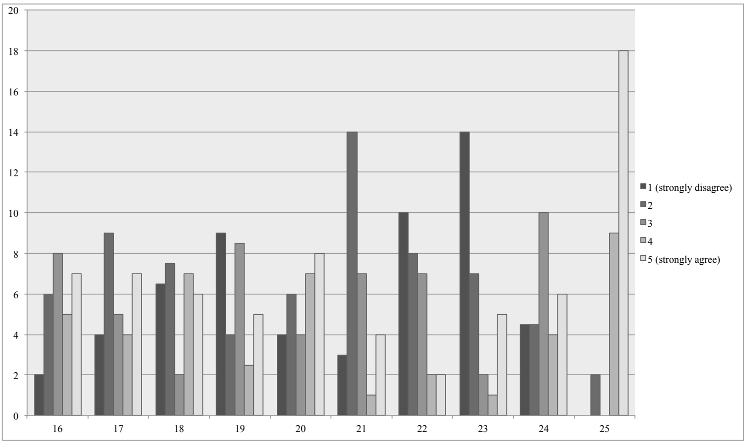
29. Har du haft et kursus i logik før?
- ☐ Ja. Hvilket, hvorhenne: ____________________
- ☐ Nej.

30. Hvilke kurser om *programmering* har du haft?

B Selected questionnaire data

Aggregate responses to questions Q6 through Q25.





The following page shows the responses to Q26 (in Danish.)

Q26 (negative)	Q26 (positive)
intet, proofweb er godt.	*1. subgoals. *2. backwad pænere grafisk
1. Giver ikke så god vejledning hvis man bruger en taktik forkert 2. I Chrome kan linjerne "hoppe" lidt rundt 3. Hmm...	*1. Hurtigere end i hånden *2. Sikker på det er rigtigt 3. Hjælper med den formelle opskrivning af regler
1. Merkelig oppførsel i PWs text-editor 2. Noen (få) bugs	*1. Lettere å strukturere bevisene 2. Bruker kortere tid *3. Bekreftelse om korrekt bevis
*1. Der bør være en bedre måde, at sætte beviserne i rapporterne end screenshots.	1. Uoverskuelige beviser bliver lettere at lave. 2. Det gør det lidt sjovere at lave beviser.
1. Virker umiddelbart indviklet *2. Dårlig dokumentation *3. For stor arbejdsbelastning, når man "bare" skal lære det sideløbende med ugeafleveringer, øvelser og læsning.	*1. Når man har lært det er det godt arbejdsværktøj,. *2. Giver systematisk tilgang til bevisførsel. 3. Printer et godt formateret bevis til slut.
1. Svært at komme i gang. 2. Lidt forvirret symboler taktics sammenlignet med bogen.	1. Hurtig 2. Hjælpsom
1. Syntax var nogle gange irriterende fx. manglende parenteser. *2. Fejlmeddelelserne var ikke særlig overbvisende 3. Fejl i prædikat-logik.	*1. Det har gjort kurset mere sjovt, samtidig med at løse deduktionsbeviser. *2. Hurtig og verificerende. 3. Det har gjort kurset mere praktisk og computerfagligt. 4. Indbyggede eksempler var gode, det hjalp mig til at forstå hvordan man gjorde det (brugte ProofWeb)
*1. ProofWeb er ikke særligt intuitivt, heller ikke selvom man har bred erfaring med programmering. 2. Dokumentation er ringe. 3. Editoren er dårlig og kræver at man bruger Firefox.	*1. Man kan være sikker på at beviset er korrekt. Så man ryger ikke til genaflevering på trivielle ting. 2. ProofWeb er hurtigere end at lave sit bevis manuelt. 3. Godt at der blev brugt meget tid på at forklare hvordan man bruger PW. Dokumentationen er ikke tilstrækkelig.
*1. Dårlig platform som giver mange frustrationer 2.Tilbagemeldingerne er ofte intetsigende 3.Interfacet er ekstremt dårligt og svært at arbejde med 4. Når man laver en fejl mister man overbliksvinduets indhold. 5. Mange lange linier er svære at se og overskue.	1. Let at se mål/delmål og se hvornår man er færdig *2. Masser små opgaver at lave og se på
*1. Dårlig dok. *2. Opdeling af vinduerne i browseren (ville gerne kunne tilpasse frames) 3. Online ved dårligt net	*1. Skudsikkert når PW har sagt OK. *2. Viser når man laver "ulovlige" ting.
1. Introduktionen var lidt rodet som gjorde læringskurven lidt stejl.	*1. Har gjort det nemmere at lave beviser
1. Læringskurve (men ikke svært)	*1. Verificering *2. Hastighed 3. Kunne arbejde på samme beviser på forskellige pc'er
1. Det er buggy og selvom man installerer den "rigtige" browser er de samme bugs der *2. Indlæringskurven er for stejl - kurset er hårdt nok i forvejen *3. Det er forvirrende, man skal løse ting baglæns	? (Hvis man kan finde ud af det kan man tjekke korrekthed)
1. Det kan være svært at forstå fejlmeldinger i ProofWeb. 2. Nogle gange ved jeg hvordan problemet skal løses, men kan have svært ved at få sat det op, da ProofWeb kræver en bestemt rækkefølge for at man har de korrekt mål og antagelser for at kunne bruge en taktik.	1. Når man får noget træning og har set opgaver og fejlmeldinger kan man ofte gætte hvad problemet er 2. Det er nemmere end når jeg skriver i LaTeX
1. Forvirring ved forlæns og baglæns taktik 2. Mere besværligt end at skriv i hånden 3. Grimt interface og dårlige brugeregenskaber	1. Sikkerhed for ingen syntaxfejl (måske) 2. Datalogisk indgang til deduktion. 3. Hjælper folk til nemmere at dumpe kurset
1. Svært at vende sig til "backwards tactics" 2. Fejlmeddelelser er ikke altid tilstrækkeligt oplysende.	1. Forhøjer arbejdsglæden ved at løse beviser 2. Hjælper til at forsikre én om, at man har forstået reglerne korrekt. 3. Mulighed for at arbejde sig beglæns igennem et bevis.
1. Det er ikke brugervenligt *2. Det er ikke intuitivt. 3. Editoren virker dårligt.	1. Hvis man får et rigtigt svar er beviset korrekt. 2. Hvis man kan gennemskue det er det sikker godt. 3. Hvis det gav et bedre førstehåndsindtryk ville man nok ikke være så kritisk ved det.
*1. Det virker ikke i andet end Firefox. 2. Notationen giver ikke altid mening. 3. Alting skal gøres med INSERT BLAH	*1. Man kan blive ved med at prøve til det lykkes. 2. Når det lykkes er man sikker på, at det er rigtig. 3. Det aflaster instruktorerne = hurtigere feedback
1. Dokumentationen er elending, man sidder og gætter sig frem ved trial-and-error. 2. Formatet og understøttelsen er ringe (kun én browser virkede det korrekt i), og ved tabt internet forbindelse, eller ingen internet forbindelse (f. eks. i toget på vej hjem fra eller til instituttet) kan løsningen ikke benyttes — hvilket er meget skidt, fordi det er dér jeg laver mange af mine lektier og øvelser. Løsningen skal helst være mulig at benytte offline også. 3. Man brugte mere (spild-)tid på at lære, at få ProofWeb til at makke ret, end på at løse opgaverne, hvilket faktisk havde en negativ effekt på både forståelsen af hvad man lavede, samt demotiverede en fra at fortsætte med at lave lektier — resulterede ofte i at tage en pause af ren frustration over at det ikke virkede.	1. Jeg synes godt om idéen bag det, men ProofWeb lever ikke op til den nødvendige brugervenlighed (mht. dokumentation, syntaks, etc.) 2. Det var fedt at få noget visuel feedback på, hvad man lavede (herunder bevis-boksene nederst til højre). 3. Det var reassuring at få at vide, at hvis ProofWeb sagde god for et bevis, så var det også korrekt — bare ærgeligt at jeg ikke nåede at få lært at bruge det ordenligt.
*1. Besværligt at lære/vende sig til (mest forvirring mellem forwards/backwards)	*1.Bekræftelse på validitet af beviser
1. Front-enden til ProofWeb er elendig: grim, bugget og kun brugbar i Firefox. Generelt et lavt brugervenligheds niveau. 1½. Fejlbeskederne er næsten ubrugelige. Tit ofte kryptiske, andre gange forkerte. Det er meget svært at vide om man har lavet en syntax eller sematisk fejl, og/eller en taktisk fejl. 2. En god dokumentation samt eksempler er ikke eksisterende. Selv den udleverede hjælp er ikke så udtømmende som ønskeligt er. 3. Introduktionen til ProofWeb var meget forvirrende. Fair nok - man lærer programmering bedst ved selv at lege med det, men en langsom og præcis introduktion til konceptet havde hjulpet.	1. Mulighed for at verificere ens løsninger 2. At det ikke er nødvendigt at bruge lang tid på at sætte et pænt bevis op i LaTeX, men i stedet bare kunne kopiere proofweb-taktikker. 3. Mulighed for at "brute-force" et bevis: forsøge sig med kvalificierede gæt på taktiskemuligheder, uden helt at vide hvor det fører hen. Dette kan tage uendeligt lang tid i hånden.
1. Introduktionen til ProofWeb gik alt for hurtigt, og mange fangede det ikke første gang. 2. Interfacet opførte sig underligt til tider. Det var irriterende at skulle skifte browser (Fra Chrome til Firefox) for at funktionaliteten var tilstedeværende. *3. Den officielle dokumentation var ikke særlig god.	1. Smart at kunne tjekke om ens bevisstrategi var lovlig.* 2. Man sparede meget tid ved ikke selv at skulle skrive sit bevis ind i TeX, eller andre skriveprogrammel. 3. At underviserne var hurtige til selv at udgive dokumentation og guides til brugen af ProofWeb. De fleste på kurset ville måske have været mere positive over for brugen af ProofWeb, hvis disse guides var tilgængelige, så snart ProofWeb kom ind i undervisningen.
Proofweb er ret buggy Det er ret svært at komme i gang med, fordi måden det bliver gjort på ikke nødvendigvis giver mening	Det gjorde det mere sikkert at ens beviser var korrekte* Det gjorde det hurtigere at løse opgaver Det var nemmere at strukturere ens beviser helt korrekt*
1. De fitch style proofboxes man lavede kunne vokse vildt store, og det var ikke altid der stod det helt rigtige i beskrivelsen af hvilken deduktion der var brugt.	1. Sikkerheden i at beviser er korrekte * 2. Nemheden i at tilrette eventuelle fejl *
- Lidt besværligt at bruge (kender ikke alternativerne) -* Blev brugt for tidligt til predicate logic (blev ikke selv god nok til papir)	+* Digitalt arbejde med beviser + Verificering af beviser + Introduktion til proof assistance
* Det tager tid at lære og var svært indtil man kom ind i tankegangen	- * Det er rart at få tjekket sine svar. - Det går hurtigt, når man har lært det - Muligheden for at aflevere proofWeb udskrift i stedet for fx latex - jeg har brugt lang tid på at skrive ind i latex...
*Jeg gider ikke webinterface. Hvad med Proof General i stedet eller som alternativ?	*Det hjælper sikkert. Jeg tog mig aldrig sammen til at bruge det.

3

Developing the course “Assessment of Insulin Sensitivity in Metabolic Active Tissue”

Sara Gry Vienberg

Section of Integrative Physiology, CBMR, Faculty of Health and Medical Sciences, University of Copenhagen

Background

A big wish from several of the PhD students in our department as well as our neighboring departments at the Faculty of Health and Medical Sciences, University of Copenhagen is more PhD courses with “hands on” experience in the laboratory and not just PhD courses with a more theoretical approach of a given topic.

We are a newly established department within one of the Novo Nordisk Foundation sponsored research center clusters’ and therefore do not have any obligations to teach. However, one of the missions within the Center for Basic Metabolic Research and our department of Integrative Physiology is to attract and educate world leading scientists. In an attempt to bridge this paradox of no teaching obligations and our vision for the center to educate world leading scientist as well as attract new young students for research, we plan to conduct a PhD course within our field of research with the title: “Assessment of Insulin Sensitivity in Metabolic Active Tissues”. To fulfill the wishes of our PhD students we want to make this course practical so the students get the proper training in the laboratory and subsequently directly benefit from the taught techniques and experimental designs in their own research projects.

The aim of this project is therefore to plan the above mentioned PhD course, with a clear course description, intended learning objectives, teaching/learning activities and how the students learning outcomes are evaluated. The report therefore reflects my current effort to design and establish this new PhD course and at the same time serves to meet the requirements for passing the course in university pedagogy.

The need for the intended PhD course

All our graduate (PhD) students are enrolled in the Health and Medical Science Graduate Program called Basic Metabolic Research. The overall goals for PhD students graduating from the Health and Medical Faculty are that they are capable of designing and executing research projects, acquire a broad knowledge base, as well as critical, creative and precise experimental skills. The graduate program within Basic Metabolic Research is meant to provide the training environment for metabolic research within the Copenhagen area, with special emphasis on glucose and fat metabolism, obesity and diabetes. Looking at the PhD course catalogue offered by the Basic Metabolic Research program at the Health and Medical Science Faculty and from related graduate programs from other universities, it becomes clear, why our PhD students are asking for more PhD courses specifically with a practical approach within diabetes and metabolism research, since very few are offered, at least during 2014. The intended PhD course will in other words fill in a gap in the current offered PhD courses.

Constructive Alignment

The planned PhD course will be designed, applying Biggs & Tang (2011) theory about constructive alignment. Constructive alignment basically states that the relation between the intended goals for a given topic, the teaching activities and the evaluation depends on the students learning before the intended goals can be achieved. Therefore, according to Biggs & Tang (2011) the key to obtain a course with a constructive alignment are the intended learning outcomes (ILOs). When the ILOs have been generated, then decision as to how they are taught and assessed are to follow. The ILOs should be expressed as which constructive activities are most likely to achieve them. As summarized in figure 3.1, activities are in this case verbs, so the verbs should specify what the students should do in order to learn the activity being taught.

In principle, constructive alignment of a given course should be reached when teaching/learning activities (TLAs) implement the verbs stated in the intended learning outcomes, which are then used or acted upon in the TLAs and the assessment tasks.

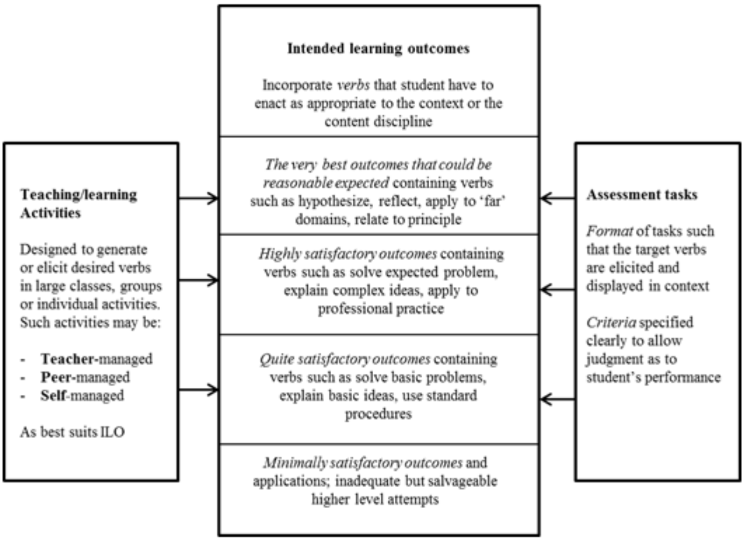


Fig. 3.1. Aligning intended learning outcomes, teaching and assessment tasks (Modified from Biggs & Tang (2011), p105)

Designing intended learning outcomes

The course I wish to design should particularly support the students' ability to design studies addressing insulin sensitivity in metabolic active tissue as well as conducting the studies/assays themselves and being able to critically analyze and evaluate their generated results during the course. From the principle of constructive alignment it is clear that designing the intended learning outcomes is the most essential element in the course design as it impacts both the teaching activities as well as the assessment tasks.

In order to design intended learning outcomes it is important to determine what kind of knowledge is to be learned, *declarative or functioning*. Biggs and Tang define declarative knowledge as knowledge about things or "know how" whereas functioning knowledge is knowledge that gives the learner ability to do things (Biggs & Tang 2011, pp. 81). In other words, we want the students to develop competencies, where competencies are defined as a knowledge-based foundation to act appropriate in situations, which includes a specific kind of professional challenge Busch et al. (2004). It is also clear from our students' perspective that they wish a course which gives them functional knowledge and competencies, which make them able to add their already obtained declarative knowledge and research experience within metabolism.

Another consideration to do before writing the intended learning outcomes is what level of understanding is intended. Is it enough for the students to be able to do an experiment without knowing why they are doing it? Several learning taxonomies address this important point. The Structure of Observed Learning Outcomes (SOLO) taxonomy gives several examples on verbs to use in intended learning outcomes depending on what level of understanding is intended for the course (Rienecker et al. 2013, pp. 102). This learning taxonomy is divided into a multi-structural or quantitative and a relational or qualitative level of understanding. If the intended learning outcomes are at the quantitative level, then the learning outcomes should include verbs like mention, define, calculate, and describe. However, if a qualitative level of understanding is intended, then the intended learning outcomes should include verbs like; explain, analyze, use, discuss, evaluate and create. I clearly want the students not only to be able to describe a certain experimental method, but that they actually can perform the experiment as well as evaluate their results and put the results into a research context, so they themselves can use this technique to solve or address their own research questions. Hence, the goal for this PhD course is that the students obtain qualitative understanding and knowledge. Therefore, it is important that the verb in the intended learning outcomes reflects the appropriate level of understanding, the topic content the verb is supposed to address, and in which context of the content the verb is to be used. Of course there are also some technical and practical issues to consider, when planning a PhD course. Most PhD courses last only a week, which is also the intention for the planned PhD course. There are limits to what it possible to implement of knowledge and experience for the participants within a week, if, as stated above, the level of understanding should be relational and deep, rather than surface learning and multi-structural. The process of actually deciding the content of the course has been rather difficult, since I as well as my co-organizers/teachers for planning the course have not only different interests in science, but also very different approaches to what we think are the most important topics to cover in the planned PhD course. This has given me some hard choices to make in order to decrease the suggested content of the course, so what is practical possible to do in the laboratory and what can actually be covered within only a week and still ensure the understanding becomes relational and not just multi-structural. Thus, in this short course, the intended learning outcomes are very closely related to the teaching activities in order for the participants to be able to succeed with the intended learning outcomes. The intended learning outcomes are given in the course description in appendix A.

Designing teaching/learning activities

Teaching/learning activities (TLAs) need to be aligned with the verbs stated in the intended learning outcomes, but besides that, there are also some general characteristics, which need to be fulfilled in the TLAs according to Biggs & Tang (2007) in order to achieve the ILOs. Those include:

a) An appropriate motivational context
b) A well-structured knowledge base
c) Relevant learner activity
d) Formative feedback
e) Reflective practice and self-monitoring

An appropriate motivational context includes that the students feel trusted and are able to make decisions, have time to make the right decisions and thereby take responsibility for own learning and that the teaching activities are not seen as trivial. In addition, it has to be done in an environment with clear policies and procedures as well as having reasonable probability for success. New knowledge, should build upon already learned skills and of course the activity has to be relevant. Giving formative feedback, while the students are learning in the middle of an activity is also important both for obtaining the success of the teaching activity as well as the intended learning outcomes. However, sometime we all make mistakes and those can be detrimental for a given experiment, not to mention very expensive, however, by self-monitoring and reflecting upon which mistakes were done or what went right this time, it is possible to correct the mistake, so it does not happen twice and thereby a valuable lesson has been taught/learned.

In order to succeed with the intended learning outcomes and give enough time for the teaching activities for the participants to feel free to move and have time to make the right decisions and give formative feedback, I and the other co-organizers have had to cut a tremendously in what we to begin with, thought was a reasonable amount of content the participants should gain from our one week PhD course. The content of the PhD course is described shortly in at the course description in appendix A and appendix B shows the outline of the program for the week. Below are given a short description of the teaching activities planned and the reason for them.

Since this is a very labor and teaching demanding course with constant formative feedback, we expect no more than twelve participants and these will be divided into four groups of three. Each group will have an animal FELASA C license holder as instructor/teacher, not only to ensure formative feedback to the participants and that the experiments run smoothly, but also to ensure animal ethics and welfare.

All teaching activities are planned, so each new technique or exercise builds upon knowledge obtained from the previous exercise. The first teaching activity is to anaesthetize a mouse by intra-peritoneal injection. We expect that most participants have previous experience with animals, but in case there are a few, which does not, then this is a good opportunity to learn how to catch, handle and inject a mouse. If the injection is successful, the mouse will stop moving within a few minutes. When the mouse is anaesthetized then the participants will practice retro-orbital injections (this will be used in another experiment later in the week) followed by opening up the abdominal cavity in the mouse and try to do a vena cava injection before dissecting all the metabolic tissue. This might be a trivial exercise for participants with a lot of animal work experience, however, they should also know, that you cannot practice enough when it comes to animal experiments. There is always room for improvement and refinement.

This teaching activity will be followed up with doing vena cava injections on anesthetized mice, with either insulin or saline for five minutes before tissues (liver, fat and muscle) have to be removed and snap frozen in liquid nitrogen for further analysis of the insulin signaling pathway. The samples generated will be analyzed by Western blot during the week and will give a clear-cut answer about whether the vena cava injection with insulin was successful or not. To add an additional layer of context and give an idea about what this kind of experiment can be useful for in terms of insulin sensitivity assessment, the participants will be given mice which have exercised prior to the insulin stimulation or been sedentary. At the last day of the course, the participants will assess whether exercise leads to increased insulin signaling as hypothesized or not in the tissues examined. The exercising of mice will not be performed by the participants, but they will be told the principle behind it and shown the custom-made treadmills we use for mice. The day will end with a 5 – 10 min presentation from half of the participants about their current research, so they partly get to know each other and partly can give feedback to each other about, where they can see the practiced methods being used in their own research. Since the day is already very packed, there will not be time for all participants to present their current work on Day 1, so the other half of the participants will present at the end of Day 2.

At the second day of the course, the participant will either perform isolation of primary adipocytes or do insulin stimulated glucose uptake in vivo using radioactive labelled glucose in mice. Both experiments require handling of the mice and i.p. injection of anesthetics, and dissection, repeating some of the techniques used at Day 1. Again, the participants will handle mice, which have been exercised or stayed sedentary prior to the experiments. The primary adipocytes will be examined for their insulin stimulated lipogenesis and inhibition of lipolysis also in the context of exercise, which is supposed to increase insulin sensitivity. The insulin stimulated glucose uptake, demands that the participants can perform retro-orbital injections as practiced on Day 1, do blood glucose measurements as well as dissect liver, muscle and fat to assess these tissues' ability to take up and store glucose. Isolating primary adipocytes from fat instead of for example isolating hepatocytes from liver or muscle fiber from muscle, was chosen because it is rather easy and less time consuming than the other two techniques and therefore more likely to succeed. Furthermore, a lot of the PhD courses within metabolism and diabetes offered by the graduate school covers muscle biology. However, in order to assess whole body insulin stimulated glucose uptake covering all three tissues, we have chosen to include insulin stimulated glucose uptake using radioactive tracers. This method instead of the golden standard for measuring insulin sensitivity in vivo, e.g. hyperinsulinemic-euglycemic clamp, was chosen because this is durable to set up in all laboratories handling animals and does not require surgical expertise and therefore also more likely to succeed for the participants.

The Last teaching activity on Day 2 is 5-10 min presentation from the remaining half of the participants about their current research. Day 3 will be a copy of day 2, so all participants get through all methods. However, instead of the participants' presentations at the end of Day 3, we will have an invited speaker covering adipocyte biology in the context of diabetes.

Day 4 will be a data collection day. Here all tissues and samples will be analyzed by Western blot analysis, scintillation counts, etc. and the participants will put together a presentation of their data for Day 5, where all groups will evaluate their results. The day will be ended by a keynote speaker, who will give a talk about how we assess insulin sensitivity in humans and connect the advantage and disadvantages with using mice as animal models for this type of research compared to humans.

Day 5 is the day of evaluation and assessment of the participants. There are several ways to evaluate the participants' performance, but we have chosen and oral group presentation and discussion with the rest of the participants, since we believe this will be most fruitful for all participants and perhaps give us as organizers a better idea of unintended but perhaps valuable learning outcomes, for our next course. The groups will present their results generated during the week. They should be able to explain why and how they assessed the insulin sensitivity and their results will indicate how well they applied the different techniques and give reasons to what went right or wrong and why. Since it is unknown, how acute exercise affect insulin sensitivity the results generated during this planned course might, in the best case scenario, end up in a publication. However, we at least expect that this intervention with or without exercise will be used as a base for how the techniques learned during this course can be used in a research context within the participants own research and how to design or not design new studies, whether this includes projects where mice with different genotypes, diabetic vs. normal, or mice treated with or without certain drug, etc. are analyzed and thereby fulfill the last of the intended learning outcomes in the course description.

A

Appendix A
GRADUATE SCHOOL OF HEALTH AND MEDICAL SCIENCES
University of Copenhagen

Assessment of Insulin Sensitivity in Metabolic Active Tissues

The course gives the participants capability to plan, apply and interpret their results within insulin stimulated end-point assays, carried out in typically active metabolic tissues such as liver, muscle and fat from mice.
In order to put the content of the course into relevant on-going research, the participants will either examine mice which have been acutely exercised prior to the course or mice which have been sedentary and assess their insulin sensitivity in different in vivo and ex vivo settings.

Learning Outcomes
The participants will be able to:

a. Explain why and how to assess insulin sensitivity in metabolic active tissues
b. Apply assessment of insulin sensitivity in metabolic active tissues
c. Evaluate the assessment of insulin sensitivity in metabolic active tissues and present the obtained data in a clear and concise way.
d. Design and create new studies, where the participants can apply, evaluate and benefit from the assessment of insulin sensitivity in their own research

Content
The content of the course includes handling of mice, i.p. injections as well as i.v. injections both retro-orbital and vena cava, besides dissecting the most relevant metabolic tissues. Furthermore, the course includes acute i.v. insulin stimulation through vena cava, and analysis of insulin signalling in muscle, fat and liver by Western blot. The participants will learn how to isolate primary adipocytes and assess lipogenesis and lipolysis as well as to do insulin stimulated *in vivo* glucose uptake using radioactive tracers.

Weight
5 ECTS

Participants
PhD students. Experience with animal work is an advantage, but not a requirement

Language
English

Form
The primary form will be exercises in the laboratory, but there will also be group work, discussions in plenum and lectures

Dates
Fall 2015

B

Appendix B

Assessment of Insulin Sensitivity in Metabolic Active Tissues, Fall 2015

Monday		Tuesday			Wednesday		
9-9.30	Introduction and practical information	9-16.00	Group A and B	Group C and D	9-17.00	Group A+B	Group C + D
9:30-13	I.p. injectin of anaestaetics,		In vivo stimulated	Adipocyte isolation		Adipocyte isolation	In vivo stimulated
	Practise retro-orbital i.v. injection		glucose uptake	Lipolysis		Lipolysis	glucose uptake
	Practise i.v. vena cava injection			Lipogenesis		Lipogenesis	
	and dissektion of tissue						
	I.p injectin of anaestaetics, vena cava						
	injections of saline or insulin, removal						
	of muscle, fat and liver						
13-14	Lunch		Lunch, when it fits			Lunch, when it fits	
14-17	Tissue homogenisation						
	Protein concentration determination						
	Make laemli samples as well as cast gels						
17-18	Presentations by participants	16-18.00	Presentations by participants		17-18.00	Lecture by invited speaker	
		18-19.00	Social hour with drinks and snack		18-19.00	Social hour with drinks and snack	

Thursday		Fridady	
9-13.00	All groups, run of western	9.00-13	development of western and preparations
	Collect counts from day 2 and 3		of presentation
13-14.00	Lunch	13-14.00	Lunch
14-16.00	Data collection and assesment	14-16.30	Group presentations of data
	from previuos day		Evaluation of data as well as where can
			the participants see the benefits of
16-17.00	Lecture by invited speaker		the learned assays in their own research
17-21.00	Social hours with dinner		

4

Global Studies in a Material World - How far can Natural & Social Sciences Integrate?

Henrik Egelyng

Department of Food and Resource Economics, University of Copenhagen

Foreword - and Acknowledgements

An analysis of and reflections on a teaching experience suggested that one major pedagogical challenge for a teacher supervising students following a 'interdisciplinary' university course is how to go about enabling 'integration' between the social and natural sciences - i.e. a process by which data, ideas, theories and methods of disciplines are blended to be of value to students. The UCPH course in Global Environmental Governance (GEG), providing the experience, serves a double function in this paper, one a case in its own right, and one as a partial proxy case for a course which mainly exist on paper (as it just started last month). Further, the GEG course rather explicitly embodies – or calls for – workable 'integration'. It is therefore relevant to demonstrate that interdisciplinarity is not only a [subject oriented] didactic, but also a concrete pedagogical, challenge - both at the level of course design, at the level of day to day teaching and in terms of assessment practice.

In addition to the by-proxy component and reflections from teaching and supervising students at the GEG course at UCPH in 2014, qualitative methodology applied was one of a strategic case study using semi-structured interview of strategically selected respondents[1], analysis and review of literature and relevant documents such as course descriptions, accreditation report and course planning materials.

[1] Two representatives of the Coordination Committee of the GD programme (Henrik Hansen, Christian Lund), one representative of the Course in Global Environmental Governance (Iben Nathan, Course Leader) and the IFRO deputy director

I wish to thank Christian Lund, Iben Nathan, Henrik Hansen, Per Svejstrup Hansen and Michael May for their respective contributions as respondents and reviewer.

Intro

Interdisciplinarity - creating something new by crossing existing boundaries and integrating disciplines, including methods, terminology, and research - is important to address complex issues facing our world and employers want *students who master interdisciplinary thinking* (2016 Strategy, University of Copenhagen, italics added). Today this importance is widely acknowledged in scientific literature, from all realms[2], by the world scientific community and reflected in celebrations of early practitioners[3]. UNESCO speaks of a coming post-disciplinary age in which the social sciences and hard [natural] sciences can *integrate* (2010: 189, italics added). Among the drivers for the vision expressed in the UNESCO report is a past frustration of what I would call a significant further *potential for alignment* between the nature of the mainstream (western) social science, including economic, disciplines and the diversity of cultures and realities existing throughout the world.

A motivation for this paper is to pursue understanding of and reflect upon how courses at UCPH may be further improved in respect of a new disciplinary communality, if not integration, and constructive alignment between course content and global cross-cultural realities, as well as the fact that we all live in a finite material biogeophysical world on a single planet.

Exploring – by proxy - the case of a new MSc. programme in Global Development (GD), we ask whether and how the GD programme could perhaps strengthen its interdisciplinarity to further exploit its close institutional location close to the bio-geo-physical disciplines at the UCPH Faculty of Science, and further strengthen its partial foundation at the Department of Food and Resource Economics (IFRO). A sub question investigated

who followed the evolution of the GD programme, in his capacity of leader of studies (Per Svejstrup Hansen)

2 see e.g. Darbellay and Stock 2012, O´Shea 2012, Andreatta et al. 2011, McCarl 2010. This is also the case within the social sciences where the importance of ‘opening up’ has long been acknowledged - although as ‘to whom and for what’ has remained more of an open question (Burawoy 2007).

3 see e.g. (Turner & Fischer-Kowalski 2010)

is whether and how a course in Ecological Economics (EE) could serve to this end. Given the fact that the GD programme is yet to complete its first semester [ever], a course on Global Environmental Governance is used as a partial ‘proxy’, i.e. for methodological reasons, see appendix A.

Constraints facing interdisciplinarity

Complex barriers and serious challenges and constraints continue to work against interdisciplinary research and research collaboration (König et al. 2013) - and thus against interdisciplinary research based teaching. At the same time funding agencies increasingly invite design of inter- or trans-disciplinary research programs, and scholars call for the need ‘to go beyond assembling multidisciplinary teams’ (Wilk 2012). Some of the constraints are fundamental, rooted in epistemology, different choice of scales of analysis or assumptions about human nature, and different institutional arrangements such as organizational divides, and specialized journals (Wilk 2012). Some are related to age of the performers or strategic value of the research (Rijnsoever & Hessels 2011)(see also appendix A). So, ‘Inter’ is contested space, inter-disciplinarity has many definitions[4] and ‘degrees’ (see appendix A). For the purpose of this paper we shall rely on the illustrations in figure 4.1, which carry these (selected[5]) definitions:

- multi-disciplinarity: people from different disciplines working together, each drawing on their disciplinary knowledge;
- interdisciplinarity: integrating knowledge and methods from different disciplines;
- transdisciplinarity - unity of intellectual frameworks beyond the disciplinary perspectives.

[4] The (US) National Science Foundation defined interdisciplinary research as: ´a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge []´(2004).

[5] See the source figure (link) for definitions of intra- and cross- disciplinarity.

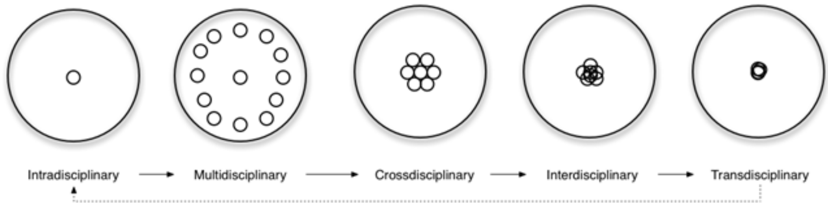


Fig. 4.1. Source: http://www.arj.no/2012/03/12/disciplinarities-2

The case of the MSc programme in Global Development (GD), at University of Copenhagen (UCPH).

The new 120 ECTS MSc programme in Global Development (GD) at University of Copenhagen (UCPH) launched in September 2014 on the background of an excellent accreditation. The graduates will bear the title MSc in Global Development and have a 'new' social science expertise - where analyzing and understanding drivers and incentives of the market economy combine with understanding culturally determined perceptions, institutions and organisations (http://studier.ku.dk/kandidat/global-udvikling/). The programme result from two years of preparation in collaboration between the (UCPH) faculty of Social Science and faculty of Science, the (UCPH) Board on Education Strategy, coordination and advisory committees as well as four meetings with user panels[6]. Planning involved a course plan development retreat followed by syllabus development and pedagogical '*montage*' - to balance lectures, exercises, and excursions, and finally the GD application fulfilled all accreditation criteria[7].

The accreditation criteria included:

(1) Demand side and match between competence goals and employer demand;
(2) Foundation in Research and research environment;
(3) Educational profile and learning objectives;

[6] including Danish Industry, UNDP, ABB, Grontmij, Danish Ministry of Foreign Affairs and Danfoss.

[7] The above section is based on interview with one of the founders of GD, Professor Christian Lund, 25th June 2014.

(4) Programme structure, design and planning, including alignment learning objectives and assessment and evaluation, and obligations to apply existing guidelines for pedagogical quality assurance and standards, and finally
(5) Use of continuous quality assurance systems, including a UCPH teaching quality assurance systems in accordance with the European Standard Guideline (ESG) monitoring the curriculum and ensuring (certified) teacher qualifications (Akkrediteringsinstitution 2013).

One source of inspiration to develop the new MSc in GD was an individual experience which I believe is perhaps similar to the India-experience allegedly laying the grounds for Ester Boserups transformation into ‘An interdisciplinary visionary relevant for sustainability’ (Turner & Fischer-Kowalski 2010)(see appendix A). GD was envisioned to allow a more holistic understanding of development processes, providing students an interdisciplinary understanding early enough to optimize their competences as ‘developers’. However, aware of the great challenge many economists experience in interaction with the bio-geophysical sciences, which have a longer time perspective than that of the market (now or near future) and the political system (next election), founders defined the GD to be a predominantly social science education, the interdisciplinarity of which would be limited to reach across a handful of social science disciplines sharing an anthropocentric view of the world[8].

The GD curriculum and intended learning objectives

Globalization processes, living conditions and economic growth are core concepts to the [2 year master] GD education. The programme will concentrate on ‘social science aspects of global development’ and educate students to ‘understand, analyse and act’ in this ‘new globalized reality’ (http://studier.ku.dk/kandidat/global-udvikling/). Students are expected to ‘undertake relevant job functions’ and ‘qualifying them for enrolment in a PhD programme in global development’ (KU 2014) – a statement reflecting that there is no consensus on the extent to which GD is/should be a research education – one of the founders will be satisfied if around 10% of the students can be recruited as ph.d. students, another rejected the idea of GD as a research education.

[8] The above section is based on an interview with one of the founders of GD, Professor Henrik Hansen, on 3. Juli 2014.

The involvement of Department of Geoscience and Natural Resource Management and IFRO means that while the GD is mainly a social science education, formally speaking it is a combined Social Science – Science faculty venture. With a first year featuring six mandatory courses plus a three week 'fieldwork' stay [in a low- or middle-income country], a second year of 'choice' combining optional courses, more fieldwork and internship, and finally a thesis (cf. figure 4.2) opportunities exists for all GD partners to contribute: IFRO and Science has responsibilities vis-à-vis the field course(s) and the field course therefore provide some opportunities for demonstrating to students the relevance of Science disciplines and the opportunities to follow Science courses in the 'open window' of the GD[9].

ECTS:	7.5	7.5	7.5	7.5
1st semester	1) Global Development: Theories, Facts and Current Issues	2) Advanced Research Methods in the Social Sciences	3) Global Business and Economics	4) Transnational Actors, People and Placemaking
2nd semester	5) Global Politics	6) Economic Growth and Inequality	7) Field Methods/Field Course (15 ECTS)	
3rd semester	Study abroad, internship and/or courses within social science (30 ECTS)			
4th semester	Thesis (30 ECTS)			

Fig. 4.2. Source: KU. 2014

The GD course catalogue is broad, comprising introduction to development theories, qualitative and quantitative (social science) research methods, a private sector oriented component introducing students to international trade, FDI´s, value chains and finance, an actor oriented component, a component on global politics and one on economic growth (and distribution). All the courses have themes, where at least 2 different disciplines are represented and the field course – following the otherwise multidisciplinary elements - will 'integrate methods and disciplines'[10]. Exam

[9] Interview with Per Svejstrup Hansen, Associate Professor, Deputy Head of Department, 27/06/14.

[10] Interview with Christian Lund. This respondent - one of the Chief Designers of the GD programme who has himself a strongly interdisciplinary profile – characterized the aim of the programme as multi-disciplinary, and the field course as the opportunity to go beyond this and explore interdisciplinarity.

forms vary significantly between the six courses (7 including the field course) and students are allocated a thesis supervisor already at the end of 2nd semester, indicating perhaps how the GD is designed for the 'new normal' of post 'progress reform'.

With about 65 students, around 13 from Germany, and 7 from outside EU (Australia, Canada, USA, China), and a majority of applicant motivation letters aiming for a private sector career, it seems highly plausible that the GD programme can 'play out' as outlined in the accreditation document.

In terms of intended learning outcomes/objectives (ILO's), the GD profile of competences includes knowledge and understanding enabling students to *'identify complex problems related to development and possess knowledge, based on the best international research, of theories and methods used to address such problems, in addition to being able to critically reflect upon this knowledge on a scientific basis'*. Expected skills include for students '*with regard to validity, reliability and applicability*', to be able to '*critically evaluate, discuss and prioritise among scientific literature and key methodologies in the field of global development*'. Finally, expected student competences include ability to 'evaluate, validate and disseminate existing data and design, carry out and co-ordinate scientifically valid and focused research, to advance knowledge in a particular problem area or issue on global development'.

Rhetorically, of course, one could ask whether including or excluding biogeophysical or 'earth' sciences is preferable in terms of the above expectations to be realistic. Based on our analysis of the GD Curriculum (KU 2014), the core disciplines of which is anthropology, economics and political science, we tend to conclude that as far as the current level of ambition is concerned, the interdisciplinarity objective of the GD programme is attempting a partial 're-pair' of the historical divorce that separated culture, economics and politics – a divorce creating narrower disciplines tending to abstract from the fact of their subject matters being integrated cultural, social and institutional constructs. While the GD curriculum aim to focus on quantitative economics, it is unclear to this analyst at least, whether this may result in 'neglect of institutional factors' sensu Gunnarsson (1991) by design.

Given certain developments since that 'divorce', including accentuation of some of the 'constraints' mentioned, this ambition is perhaps already high, despite the fact the GD components are all social sciences (only). Based on the semi-structured interviews it seems clear that scoping out into an interdisciplinarity – or transdisciplinarity - including also natural sciences is perhaps more of long term objective, at this point in time. One may conclude, therefore, that while the GD attempts opening up [nomothetic] economics to other social sciences (here anthropology and political science) and vice versa, a stronger contemporary UNESCOish, if not older 'Wallersteinian'[11] ambition of 'opening up' the(se) social sciences to other sciences, including biology and the ecological sciences, in which the UCPH Science Faculty excels, seems a more distant perspective.

The Global Environmental Governance (Diploma) course

At UCPH, the GEG Diploma course stands out as one of the few courses pursuing a real ambition of combining and drawing upon both social and natural sciences to gain interdisciplinary competences and understanding. As per its ILO´s GEG aim directly to '*equip the students with interdisciplinary skills*' and bring about knowledge on how international organisations 'interact *in relation to the task of governing the society-nature relationship*', and therefore ability to '*critically evaluate information related to social and physical aspects of global environmental problems and their eventual solutions*'. The course thus aims for students to gain 'extensive understanding' of both political and institutional issues as well as of '*natural science*' aspects of the environment, - and student competences to comprise taking '*technical, natural science and social science aspects into consideration when working with global environmental issues and problems, consequences and solutions´ and bringing ´natural science based knowledge about environmental problems into play in an international political, legal and administrative context*'. (KU 2014. GEG Course description 2013/2014, italics added). In other words, GEG has a strong element of political ecology sensu Bryant (1992).

The origin of this 7,5/10 course goes back to 2007, when a perceived need for a course with a global perspective on environmental problems was acted upon, on a background of many existing (UCPH) courses addressing the regional or EU level only. The ambitions was to give students 'a taste for interdisciplinarity', and avoid them losing their foothold in their 'traditional' disciplines, and instead supplement these with broader

[11] Here referring to the title of the Gulbenkian Commission, headed by I. Wallerstein: opening up the social sciences

multi/interdisciplinary insights´ - a notion which may be quickly illustrated metaphorically: the ‘perception of a forest may very much depend on whether you are an artist, a lumberjack or an economist’[12]. One of the GEG planning documents put it this way (own translation from Danish):

> ‘[The] most important objective is to supplement existing student competences by providing an option for students to gain experience with interdisplinary work on of relevance for their subject. Through the program [GEG], the students will thus be able to research both political and natural science and legal problems, within the field of “global environmental governance”’.

At the same time - and compared to the case of the GD (above) - the GEG course documents more explicitly address, if not fully draw the consequences of the fact that GEG will recruit many students with a (soft) natural science profile. GEG course documents says:

> ‘students from natural sciences [will] through this program gain better insights in social and legal aspects of the global environmental field. As graduates, therefore, they will have a better chance to bring their natural science knowledge to play in global og national management processes’

The same document aim to ensure the interdisciplinarity goes in both directions:

> ‘Similarly, students of law and political science faculties, will gain better insights in fundamental Science concepts and problems of importance to the global environment. It is expected therefore that as graduates they will be able to better understand and deal with natural science problems or, at least, have a better capacity to draw on or collaborate with experts having a Science background, thus adding quality to policies and management processes of essence to the global environment’

Finally, the document provides a perspective: [GEG] can be developed towards an international master’s program, with similar aims.

A 2008 report on the GEG course indicates an early plan of extending the course interdisciplinarity all the way to Biology – so far geography has been successfully integrated. The ‘inner market’ of UCPH courses is

[12] This section is based on a (SKYPE) interview with Associate Professor Iben Nathan on 9th July 2014

still evolving, meaning some ‘trade barriers’ remain in function, like some faculties having block structures where others still have semesters, some have a tradition for interdisciplinarity, some not[13].

A teaching experience informing the analysis

During my teaching at the GEG Diploma course, more particularly in my function as supervisor for student group projects, the agenda – or ambition - for my research based teaching[14] was to help the students – many of who originated from a Science background - to successfully ‘integrate’ the social science [‘governance’] dimension of the course, with the [biogeophyscial] Science dimension (See ku.kurser.dk).

The pedagogical principles applied – in accordance with the course design – was a problem oriented approach using dialogue (supervision meetings) to activate and allow students pursue in assigned ‘projects’ the intended learning objectives of the course, particularly the ‘taste of interdisciplinarity’ and ‘natural science and social science’ [integration] objective.

From these intended learning objectives of enabling students to ‘understand’ or integrate natural and social science (see ILO´s above), the following example is based on personal experience, teaching and supervising students at the GEG course, including censorship and examination: several (science) students proved fascinated about apparent potentials for stronger (environmental) sustainability identified in terms of agricultural production systems (including systems such as certified organic agriculture and permaculture) presumably demanding less energy (emergy) and causing less environmental damage compared to most existing and conventional agricultural systems. Given this enthusiasm, one challenge for the (interdisciplinary) course teachers, of course, were to ensure the same students would also understand (/learn) and be able to apply an institutional (social science) perspective, focusing on how existing or new potentials for environmental sustainability identified by the natural sciences may (or may not) come into play in a global market society by the way of social institutions.

[13] Interview with Iben Nathan, GEG course leader, July 2014.

[14] A teacher who likes to design and create didactical situations and ´activate´ my students, I oscillate between [P.]. Kugel phases ´3´and ´5´ - between focusing on students while aiming to explain so they understand, and focusing on students as independent thinkers with responsibility for their own learning

In the [contrasting] cases of certified organic agriculture and [civil society carried] Permaculture, for instance, teachers found a point of departure for combining the ´empirical´ work of the activated (mainly science oriented) students, with theoretical approaches and concepts from the social science 'governance' literature – drawing on say *constructivism* in international relations theory and concepts such as *market based non state* global environmental governance– to help students gain a conception of how any 'solution' or 'potential' for environmental sustainability can be promoted or understood [only] through a focus on actors and agency representing 'social carrying' of the same solution into markets and/or reality through institutional 'solutions' as well.

The course exams indicated that this learning objective was partially realized – i.e. at the time of exam, *not all* students seemed to have realized the importance of balancing and integrating social and natural science approaches.

A Component of Ecological Economics: A Pragmatic Option for Strengthening Interdisciplinarity of the GD Programme?

Ecological Economics (EE) is a transdisciplinary field drawing on insights from natural sciences, social sciences and the humanities, a (trans)discipline which [much like GEG students] studies conflict between the growth of the economy and the environment (Røpke 2005), and which has evolved significantly during the last few decades both quantitatively in terms of numbers of practitioners (international societies, conferences, and journal publication) and qualitatively, in terms of contributions to scientific and real world challenges and problems (Røpke 2005).

What is unique about EE is that understanding of nature's cycles and processes', including principles of irreversibility/non-substitutability of capitals (Daly & Cobb 1989), and the thermodynamic laws, is core to its analyses, concepts and views of capitals (which in EE can be of many kinds other than monetary, i.e. reflecting plurality of values), value and valorization, systems thinking, and metabolic understanding [of the economy] (Martinez-Alier & Røpke 2008). This is in contrast, not only to neoclassical, but also to much natural resource- and 'environmental' economics remaining concerned with estimation of monetary values and market contexts and principles.

In this respect, and in the eyes of this writer (see appendix A, ecological economics is a rather 'perfect match' to bridge the social and the natural sciences – and this is the reason why it is brought in here and analyzed for its potential to perhaps help along a common language, if not integration of disciplines as an overall objective, and with respect to the pedagogical challenge identified and experience by this writer in the context of the GEG course.

In this regard, the unique qualities of EE can be reflected in course (component) designs and, as in the case of an Aalborg University Campus Copenhagen course, featuring 'systems thinking' combining insight in thermodynamics and ecosystem services with material flows accounting and 'performativity' of economic theory - and thus different languages of valuation.

MSc programmes in Ecological Economics exist outside Denmark[15] and a number of universities have programmes offering degrees that include courses in EE. At the Aalborg University Campus Copenhagen, a recent initiative has established an EE course (see (AaU 2014)). Like the GEG course, AaUs EE take a point of departure in global (environmental and economic) interdependent crises. One aim is to increase students´ understanding of how (perspectives from different) disciplines can be integrated and how insights from one discipline may help question established ways of thinking in another (AaU 2014).

EE is 'programmatically open, pluralistic and transdisciplinary, so virtually unrelated contributions can appear as part of the field' (Røpke 2005). Consequently, EE has many 'surfaces' enabling a connect to or interphase with both the GD (as is), to GEG (as is), and to the natural sciences at Science. These interphases include typical EE themes like: social welfare, institutions, and governance; environmental sustainability; and resilience and evolution in socio-ecological systems.

Conclusion

Global Development students will follow an education of excellence and yet risk leaving UCPH without significantly understanding biogeophysical realities, environmental service functions of the most basic global unit:

[15] University of Edinburgh, for instance, has an MSc programme in EE, at its school of geosciences. A search for 'Ecological Economics' at ku.kurser.dk on 28th July did not return any course featuring EE in the title.

earth, let alone the irreversibility and non-substitutability between its myriads of unique natural capitals. This paper pursued the question of whether and how the GD programme can strengthen its interdisciplinarity to further exploit its institutional (here also sensu organizational) location close to the bio-geo-physical disciplines at the UCPH Faculty of Science, and further strengthen its co-foundation at the Department of Food and Resource Economics (IFRO). A sub-question investigated was how a course in Ecological Economics (EE) can serve to strengthen the GD programme, as far as interdisciplinarity and the faculty of biogeophysical disciplines, is concerned. Given the fact that the GD programme is yet to launch, the existing UCPH course on Global Environmental Governance was used as a methodological 'proxy'.

Our analysis suggest that in the case of the GD programme a *potential* to *integrate* social and natural sciences sensu Unesco (2010) exist. One *implication* of this is a remaining potential for GD in due course to move further along in a continuum perhaps as far as towards transdisciplinarity or – to use UNESCO´s terminology (from above) – a *post disciplinary* integration between the natural and social sciences.

Epistemologically speaking there is no reason why the GD programme should not transcend from the current situation of limiting its interdisciplinary scope to other social sciences to become more inclusive towards [post positivist] natural science 'disciplines'. Experience from the GEG course, however, which embody an ambition of 'bridging' social sciences (on governance) with natural sciences (environmental themes and cases and students recruited from natural science backgrounds), indicates that the bridging can be challenging and calls for special attention to building students awareness of the imperative of integrating theories and methods from 'both ends'. By default, science bachelors will find it difficult to understand the social science terminology used at the course and vice versa social science bachelors will find it challenging to fully comprehend the ecological system dynamics and how these relate to socio-economic systems. The bridging of disciplines, in other words, can have implications in terms of accentuated didactical and pedagogical challenges. Continuous analyses of student capacities and development of special cases enabling multiple disciplinary perspectives, so that all students discover the value of and contributes to interdisciplinary cooperative learning to form new types of knowledge may be one way forward.

Based on the above mentioned 'lessons' from the GEG course (as a proxy for a GD which has started, but not yet come to pass), a first – incremental - step in the direction of strengthening the levels of interdisciplinarity at GD in a way that would ‘open up’ GD to [Faculty of] Science, could be integrating the trans/non-disciplinary discipline of *ecological economics* into the GD programme.

A GD course component in Ecological Economics (EE) would serve to strengthen the GD programme – help create an ambition for the students (and therefore prospective decision-makers and future researchers) to reach out an draw also on science disciplines, including Biology, Chemistry, Geosciences, Food & Nutrition, Exercise & Sports, Plant and Enviromental Sciences, and Natural History – all the ‘bio-geo-physical’ disciplines which are major assets at the UCPH Faculty of Science.

Elsewhere EE has already created a strong tradition for - and demonstrated - interdisciplinary collaboration, allowing researchers of practically all kinds to come together in cooperative learning and pursuit of common language of sciences understanding both social and biogeophysical ecologies and processes.

GD exists within a university with a strong Science department and institutional location close to the bio-geo-physical disciplines at the UCPH Faculty of Science. As a component of the GD programme, the ‘transdiscipline’ of EE could act as a de-facto ‘integrater’ between disciplines which are so far only formally integrated. Science departments – such as IFRO – with an additional track record of performing commissioned studies for government agencies and the productive (including agricultural, food and forests) sectors, only adds options in this respect.

A Endnotes

i In other words, it is not possible to have experience from a future course, so an existing course was used, to enable analysis by proxy.

ii In addition, interdisciplinary activities are facing the following professional, organizational and cultural obstacles, here according to Wikipedia: most participants in interdisciplinary ventures (studies) were trained in traditional disciplines. Disciplinary attitudes may hinder participants from realizing full potentials of [interdisciplinary] collaboration, for instance when quantitatively oriented colleagues are perceived as missing the broader dimensions of reality or vice versa. Interdisciplinary manuscripts – and grant applications – are often refereed by mono/intra-disciplinary reviewers. Insufficient autonomy can hamper an interdisciplinary programme where (representatives of) traditional/mono-disciplines make tenure decisions. Some budget practices (still) follow disciplines.

iii For the purpose of this paper we shall rely on the illustrations in figure 1. to help us distinguish what a recent report from the Norwegian research council (Norges-Forskningsråd 2006) coined as ´puslespill, basar og heksegryte´ - denoting different degrees of interdisciplinarity, and with 'heksegryte' perhaps equivalent of transdisciplinary.

iv One of the founders of GD, working as an economist in Vietnam, experienced and reflected upon a cultural dimension completely outside the field of economics and so rather impossible to meaningfully integrate into the economic discipline, despite the fact that such integration is assumed by policy-makers and other commissioners of economic analyses of (in casu) household economics in (casu) Vietnam. Reflecting on this experience, the economist found that unless both strengths and weaknesses of the different disciplines are truly acknowledged, disciplinary schauvenisme may result – and so it seemed important for him to support education ´across´ the disciplines. His vision with GD is that it will help to avoid stereotypes, such as anthropologists perhaps generally perceiving economists as 'neoliberal devils', and instead get to understand the background for economic concepts, and similarly perhaps help economists avoid ignoring 'externalities' or quantifying subject matters they really do not understand, but simply has 'power' to quantify in a certain way. This would also help balance a perceived tendency for Antropologists focusing on the 'loosers' in development processes and perceived tendency of economists looking for 'winners'

- and perhaps help Antropologists understand why economists are fond of markets and economist understand culture.

v Personally, I am one of the ecological economist with a ´double identity´ (Røpke 2005, pp. 286), in casu one in which my core identity is one of a development researcher (my Ph.d and Master degrees are in development studies), while my identity as an ecological economist is a matter of de-facto rather than de-jure.

Part II

Evaluating and revising existing courses or units - course development

5

Increasing collaborative learning and knowledge exchange in a case-based learning environment

Stéphanie Horion

Department of Geosciences and Natural Resource Management, University of Copenhagen

Setting the scene…

Bridging the gap between theory and practise, between declarative and functioning knowledge, can be achieved through case-based learning activities CBAs (Biggs & Tang 2011). However to be relevant cases need to address the intended learning outcomes ILOs in a sufficiently complex manner allowing the students to hypothesise, to reflect on their management of the case, in other words to challenge the knowledge their have acquired during or prior the course. Often used in CBAs, group works make use of student-student interaction to increase and/or strengthen student knowledge by encouraging the elaboration or reformulation of known concepts, by developing reflective and critical thinking (i.e. how does one arrive at a given interpretation/conclusion? How what someone else's interpretation of a concept relates to my own interpretation? Is it better or worse than my own interpretation/conclusion?), and by applying theory to practise.

For this project I chose to focus on a 7.5 ECTS master course in Geography and Geology that makes use of group works as way to foster student's functional knowledge. This course is the second part of Remote Sensing of the Bio-Geosphere [1] and runs in block 2 over 7 weeks at a pace of bi-weekly classes (Mondays and Fridays). A contrary to the first part of the course that aims at providing the students with a general theoretical (lectures) and practical (guided exercises) background in remote sensing of the environment, the second part of the course is dedicated to the realisation

[1] course overview at: http://kurser.ku.dk/course/ngek10009u/2013-2014

of a scientific project in remote sensing. Main actors of the course content, the students are asked to work in small groups (2-4 students) on a topic of their choice and to perform a complete scientific analysis from designing the study to synthetizing their results and conclusions in a scientific report. To do so they need to find relevant scientific papers related to their topic of interest and identify the appropriate datasets and relevant methods to analyse them. Several seminars or guest lectures are also part of the course agenda. They are meant to introduce the students with tools/methods that can help them for their project. The final assessment is done at the end of the course in the form of an individual oral examination, where the written project report is used as starting point.

Problem Formulation

Students from the previous years usually showed interest and motivation in this course and in their project. However the previous teacher pointed out that there was a lack of investment in specific types of learning activities, i.e. those that the students did not consider as directly useful for their own project such as reading and discussing papers selected by the other groups. This can be explained by the fact that the students are only assessed based on their final report. As the topics and methods covered by the groups may differ greatly, understanding what the other groups are doing may, in the point of view of some students, seem not relevant for reaching their goals (i.e. solving the issues specific to their project and ultimately passing the exam). However despite the differences in topic, it appears quite often that different groups use similar datasets, methods or face similar technical problems. Therefore they could directly benefit in exchanging information with each other and in sharing their experience of solving issues related to their own project. If all the groups and students engage in a constructive manner, i.e. if they all contribute to the discussion, this type of student-student interaction can lead to an overall increase of knowledge in the class. This is known as "collaborative learning" (Dillenbourg 1999). Collaborative learning allows students to benefit from one another's resources and skills, and this has been shown to improve the quality of the student experience, the depth of student thinking, and their learning of science itself (Osborne 2010).

In the previous course setting, learning activities meant to increase dialogue between groups and critical thinking already existed but as reported by the previous teacher, some students did not really engaged in these activities. A typical example of behaviour was the following: each group had to present a scientific paper considered as reference for their topic and all other students were asked to read the paper beforehand. However only a limited number of students did actually read the paper, sometimes resulting in non-productive discussions in class. The previous teacher tried to solve this problem by selecting an opponent group that would lead the discussion in class. But this resulted in the absence of some of the students that were not involved in the process (i.e. not presenting and not part of the opponent group). This example illustrates one potential drawback in courses where group work is the dominant TLA: some students become “impermeable” to what the other groups/students are doing; they show very little interest or are not present in class, clearly signalling that this specific activity is a misuse of their time.

However there are many good reasons why students should engage (even slightly) in works done by their peers. Besides the fact that it gives them the possibility to approach quickly another scientific topic, it also allows them to make important parallels with their own project (in term of topic, data or methods), to critically discuss thematic or methodological issues with students outside their own group, to bring their attention to new solutions not identified within their own group, and ultimately to bring forward their own research. Therefore my research question in this project is:

> “In a course where the major part of the time is allocated to case-based leaning in small groups, how to promote collaboration between group as way to facilitate problem formulation, knowledge exchange, and critical thinking?”
>
> In other words, “how to involve students in collaborative learning in order to increase their own individual learning?”

Re-thinking the course structure

This course is taught in block 2[2] and runs over a total of 14 sessions (classes) that were divided into 5 guest lectures and 9 sessions dedicated to project works. The guest lectures were scheduled on the Monday’s and the session dedicated to the projects on the Friday’s. My main focus when

[2] At the time of the writing, the course is still running and only two weeks remains before it ends (Cf. TLAs for week 6 and week 7 in Figure 5.1)

re-structuring the course, and especially the sessions dedicated to project work, was to find a way to facilitate the exchange of information/knowledge between groups by involving the students and the class in a different way. Instead of sessions dedicated to 1-2 groups at a time (the other groups remaining most of the time passive), I decided to work in parallel with all the groups, splitting the sessions by themes and not by groups (Figure 5.1). In practise instead of assigning a task such as presenting and discussing the paper of one group specifically, I decided to work with smaller weekly assignments that would allow discussing the cases of all the groups in one session. This way all the groups would have the opportunity to see the other groups progressing in their research and to make a parallel to their own progress.

Main theme	Rationale of the TLA	Weekly assignment
Week 1: Brainstorming on research topics	• Stimulate students' reflection on potential topics of interest • Stimulate the creation of groups that are not solely based on friendship but also on personal research interest	Each student should: • come with at least 2 topics of interest • start thinking of potential groups
Week 2: Presentation of the research questions and related data	• Help the students to formulate their research questions • Provide a quick overview of all the selected topics to the entire class • Stimulate students' exchange on data download • Increase collaborative knowledge	Each group should: • present their research question and related data
Week 3: Discussion groups on methods	• Stimulate reflection and exchange of groups that will use similar methods in their project work • Facilitate dialog between students and encourage collaboration between groups • Increase collaborative knowledge	Each group should: • upload one reference paper on Absalon, as well as 2 questions/issues related to the methods to be discussed in class • read the method section of the reference papers and reflect on the questions posted by the groups that are part of their peer-discussion group
Week 4: Project	• Work on the project	• None
Week 5: Preliminary results	• Work on the project	Each group should: • upload their preliminary results (draft report)
Week 6: Feedbacks from discussion groups	• Provide feedbacks to the students mid-way • Increase collaborative knowledge	Each group should: • read the draft with preliminary results posted by the groups that are part of their peer-discussion group and prepare some constructive feedbacks
Week 7: Project	• Complete week dedicated to the project (3 sessions)	• None

Fig. 5.1. Overview of the main themes (/TLA), their rationale and related assignments for the 9 sessions dedicated to project work.

Besides Tamir (1989) argued that a reason why case-based lessons in science teaching (in his case, laboratory lessons) sometimes failed to lead to deep learning was that the students were not familiar with the process of scientific inquiry. Therefore I organised and planned the themes in a way that resembled to the different stages of scientific inquiry/reasoning: building an hypothesis (identification and formulation of a research question – weeks 1 and 2), designing of an experiment to test their hypothesis (identification of relevant data and methods – week 3), testing their hypothesis (carrying-out the analysis – weeks 4, 5 and 6) and formulating a conclusion based on their experimentation results (synthetizing their findings in a scientific report (weeks 5, 6 and 7).

Creating the environment facilitating the exchange of information, discussion of issues and feedbacks was also one of my main concerns. I decided to use peer-discussion groups, grouping several projects together, as way to facilitate informal but constructive dialogue between groups. In practise two sessions were dedicated to discussion group: one on methods and one on preliminary results. The discussion groups were set based on the similarity of data and methods used in the projects. At the time of writing only one group discussions has been organised, the one on methods (the next one being scheduled next week). The way the 1st discussion group was organised was the following. A week before the class each group had to upload on Absalon one paper they considered as reference in their topic, as well as two questions related to the method section of the paper that they would like to discuss during the group discussion. Each student had to read before the class the method sections of the reference papers and reflect on the questions posted by the other groups that were part of his peer-discussion group. Annexe A shows the guidelines given to the students to structure the discussion and provide feedbacks during that session. I decided not to intervene in the group discussion in order to give the students enough time to create an informal environment facilitating to the formulation and discussion of methodological issues. At the end of the time allocated (30-45min.), we extended the discussion to the entire class (me included), focussing specifically on remaining issues.

Considering different levels of interactions in the class (Figure 5.2) is supposed to create a favourable environment for constructive communication between students. Within the basic working entity (i.e. 2-4 students working on a project), the students can formulate their hypotheses, solve basic or more complex issues and identify other issues that they cannot solve based on the current knowledge of the group, all this in a safe environment. Within the discussion group, the students can test their hypothesis and re-formulate/discuss remaining issues with a new independent small audience. Finally dialogue engaging all the students in the class and the teacher are carried out at the end of the ‘interaction chain’ therefore allowing more advanced discussion as the students have already formulated and re-formulated their issues.

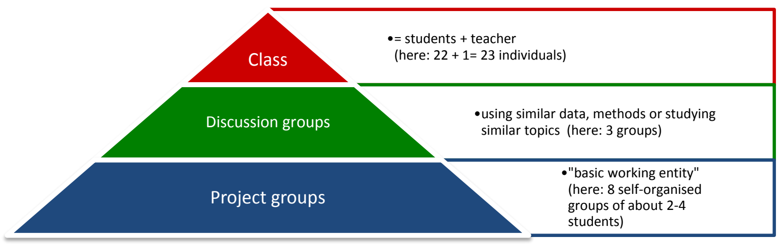


Fig. 5.2. Pyramid illustrating the different levels of students-student interactions and students-students-teacher interactions in the new course setting.

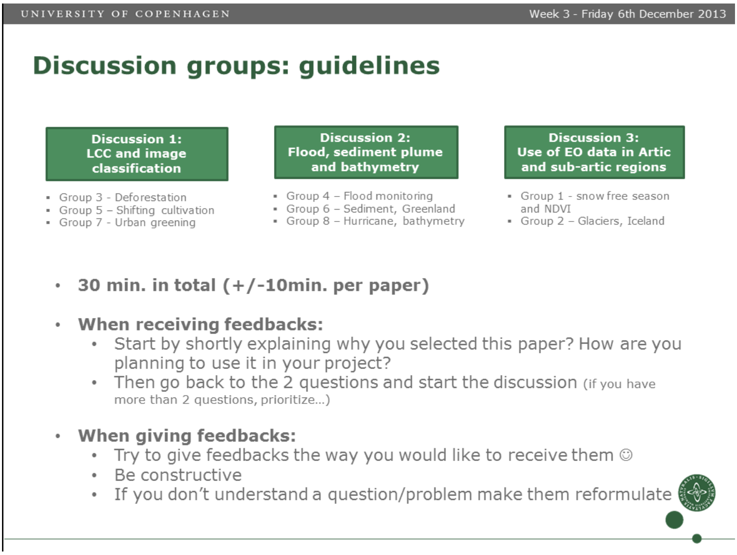
Course evaluation and personal reflections

To evaluate the success of the re-structuration of the course, students were asked to fill an evaluation form on the last day of the course (see Annex B). It was designed to understand whether the new structure of the course helped the students in realizing a scientific project in remote sensing on a topic of their choice. Students’ participation to this evaluation was about 30%. Overall the students had a positive impression on the course. A large majority qualified the course as a fruitful learning experience and was satisfied with the work accomplished in the project. Students also agreed that the general structure and the teaching activities of the Friday’s classes (dedicated to project work) helped them structuring their work, formulating their research questions and solving technical / methodological problems. Concerning the student-student interactions in class (that notably took place during peer-discussion groups), despite the fact that students are not sure whether they gave good feedbacks to their peers (Q11), they generally agreed that interacting with other students helped them understanding better the methods they are using for their project (Q7). This exemplifies the fact that either reformulating a specific problem helped the students, or that the other students had the actual knowledge to answer the questions of their peers. In any case, it showed that facilitating student-student interactions, and notably organizing peer discussion groups, is beneficial in the learning process. All in all this evaluation showed that the new design of the part 2 worked well with the students, and it would be interesting to implement it again next year to see if it gives the same positive results with a different group of students.

From a personal point of view, I have been positively surprised by the students' engagement in the different activities. For the brainstorming (which led to the creation of 8 project groups), most of the students had taken the time beforehand to think of research topics that they would be keen in investigating. My only role during that session was to help identifying similarities/parallels between topics. To my opinion, the group discussions on methods worked also quite well: the students were engaged in constructive discussion on scientific methods and managed their time quite well. By regrouping projects based on specific criteria (similar methods), the students understood quickly how/why this activity could be beneficial for their own project. It also increased their awareness of the importance of providing constructive feedbacks to the others, and in that sense involved them in a broader scope that was increasing the collective knowledge of the class. Moreover the fact that week after week the TLAs involved more and more advanced types of verbal exchange in class (brainstorming week 1, presentation week 2, discussion group week 3, etc.) helped the students to feel at ease with discussing with their peers and with me about topics that they did not fully master. The students were also part of the re-structuration process for this course, as they were asked at several occasions to state their preferences concerning the way to proceed with the activities and with the way the student-student interactions were taking place. Notably for the second group discussion, I let them free to decide whether they wanted to continue with the same discussion groups or if they wanted to change. They were also the ones setting the deadline for uploading their preliminary results.

It is important to note that, in order to be successful, this kind of course setting needs to occur in an organised but friendly/informal environment in order not to avoid competition and discouragement/disengagement of the students/groups that may lack behind. The role of the teacher is quite important as it needs to ensure that all groups/students understood the way the course is organised, what is expected from them and what will be the role of the teacher during the activities (Biggs & Tang 2011). In this course I made sure to explain the rationale of the course setting and the ILOs for each session. I also made it clear since the beginning that the goal of the project was not to discover brand new scientific facts but more to give them a taste of what conducting a scientific project looks like. Therefore I tried to emphasize the fact that there are no negative results. Indeed in learning processes "knowing what is wrong matters as much as knowing what is right (Osborne 2010)". The most important is to discuss honestly the results and to try to identify how these results can bring forward their research field.

A Guidelines for the discussion groups



B Evaluation form to be handed out to the students at the end of the course

Number of students registered to the course	23
Number of students that answered the questionnaire	7
Number of students that indicated not having attended the course	0
Percentage of answers	30%

	I strongly agree	I partly agree	I neither agree nor disagree	I partly disagree	I strongly disagree	I was absent
Related to the general structure of the Friday's classes:						
1. The Friday's classes helped me/us structuring our remote sensing project	4	2	1	0	0	0
2. The Friday's classes helped me/us organise my/our time	2	5	0	0	0	0
3. The Friday's classes helped me/us solving technical or methodological issues	5	1	1	0	0	0
Related to the formation of the groups and the selection of the research questions:						
4. I found the brainstorming session useful to form the groups	2	3	2	0	0	0
5. I worked on a topic that was close to something I suggested or something that I found interesting	6	1	0	0	0	0
Related to the presentation of the research questions:						
6. The short presentation in week 2 was helpful to formulate our research question and to get started with the project	5	0	1	1	0	0
Related to the discussion groups on method:						
7. The group discussion helped me to understand better the methods we applied in our project	1	4	0	2	0	0
8. The other groups provided us with good feedbacks/comments on the methods described in our reference paper	1	3	2	2	0	0
9. Reading the reference papers of other groups helped us to progress in our project	1	1	1	3	1	0
Related to the interaction in class:						
10. The other groups gave good feedbacks/comments on our project during the course	0	2	4	1	0	0
11. I think I gave good feedbacks/comments to the other groups during the course	0	0	5	2	0	0
12. The teacher gave sufficient feedbacks/comments to my group during the course	4	2	1	0	0	0
Related to the remote sensing project:						
13. In our project we used one of the methods / toolboxes presented on the Monday's	6	0	0	0	1	0
14. Overall I am satisfied with the work we accomplished for this project	5	2	0	0	0	0
15. I liked working with my team mates	5	2	0	0	0	0
16. Working on this project was a fruitful learning experience	5	2	0	0	0	0

6

Historical teaching and learning practices for first-year English undergraduates – reflections for improving historical thinking

Celia Penelope Hughes

Department of English, Germanic and Romance Studies, University of Copenhagen

Introduction

Students embarking upon degree-level history can expect to be introduced to a more subtle and advanced way of thinking about the discipline. Understanding how and why historians study the past the way they do means learning how to become careful and questioning readers of historical texts and acquiring the vocabulary necessary to engage in historical discussions (Donnelly & Norton 2011). University history teachers generally anticipate that first-year undergraduates arriving in their classrooms will be familiar with some of the core practices and customs guiding historical source work as well as the particular shape and style of historical writing. Although new, the disciplinary culture these students encounter is likely to feel not entirely removed from the history classrooms they left prior to the start of higher education. In contrast, first-year undergraduates who come to the discipline without this background, enter what can often feel like an alien and daunting landscape in which they see themselves as outsiders unable to participate in historical conversations.

This project reflects upon particular teaching and learning experiences involved in an introductory history course for first-year undergraduates studying BA-level English. It explores the challenges these students typically encounter when working with primary source documents and considers what it means when history faculty ask these students to think "historically". The reflections discussed here derive from a combination of teacher-observations and student evaluations of the learning that took place in a series of document analysis tasks as part of the history course all first-year English undergraduates take in the autumn semester. "The Making of the English Speaking World" (MEW) was initially designed and continues to be run by the small team of British and American historians in the department of English at the University of Copenhagen (KUA). It is designed to provide English-degree students with a sense of the origins, development and dimensions of the English speaking world. Over fourteen weeks students study the social, cultural and political agencies that enabled the global spread of English from the fourteenth-century to the present-day. Although intended to complement the range of introductory core courses, including literature, grammar and linguistics, English students take during the first semester, an important element of MEW is to provide students with a basic grounding in historical methodological practices. Particular focus is given to teaching students how to read and analyse historical documents as a means of addressing historical problems.

This project was guided by my experiences as a newly-appointed Assistant Professor of British History teaching this course for the first time in autumn 2012. Previously, I had only ever taught history undergraduates in the United Kingdom, and was unprepared to meet the specific teaching and learning demands this new disciplinary, linguistic and cultural setting presented. I was particularly struck by the confusion and quite often difficulty Danish students displayed around historical documents when asked to use them to make sense of a particular historical problem. Together my teaching and their learning experiences forced me to confront the new demands I faced as a higher education history teacher in KUA's English department that suggested important pedagogical lessons for my practice. My students' frustrations and excitement working with unfamiliar historical texts and methodological tools prompted me to consider what our teaching and learning experiences might tell us about what it means for these students to learn to think as historians and what strategies might guide them towards the kind of understanding they need in order to exercise 'historical thinking behaviours' to interpret and find meaning in historical documents and to engage in historical conversations (Tally & Goldenberg 2005).

It is worthwhile thinking in more detail about some of these behaviours and how students acquire them in order to fully illustrate the value of this pedagogical study. Historians who teach undergraduates and school teachers who teach post-16 history are in general agreement about some of the particular skills and cognitive processes students should be expected to exhibit when working with historical documents. These include being able to assess, evaluate, and compare texts within their specific historical context, to reach defensible conclusions about historical problems, and to understand how and why historians find different meanings in the documents they examine. Pedagogical scholars like Sam Wineburg have made valuable contributions to the scholarship of history teaching and learning with their discussions about the important role document studies play in helping students to master ‘the habits of historical thinking’ (Wilson & Wineburg 2001, Wineburg 1991, 2000, 2001). Wineburg argued that when students are given opportunities to explore primary and secondary sources in depth, they most closely approach the kinds of cognitive and emotional thinking – evaluating and inferring drawing upon appropriate historical context – that professional historians typically display (Wineburg 2001). Research has shown that students who practice these habits with historical source work ultimately perform better in the humanities and in the sciences because they develop the critical thinking skills engrained within these fields (Brown 2000). Such findings illustrate the important contribution historical source work offers to undergraduates embarking upon their English-degree studies. It suggests the potential pedagogical value of thinking more carefully about how to best foster student learning in this area. When performed well, source work offers to produce more highly achieving graduates equipped with the intellectual and emotional habits for participating in the “knowledge society” (Pickles 2011). The development of clear guidelines and models of practice is crucial if, as history teachers, we are to fully realise our professional responsibilities towards our students. We should see these as contributions to creating a disciplinary culture in which we aim to share with our students “love” for our subject and its value in cultivating their “full potential” as scholars, “learners and citizens” (Booth 2004).

Such ambitions present considerable challenges. As historians researching and teaching outside our discipline, we lack the cultural security that comes from belonging to a community of professional scholars and students fluent in, or at least familiar, with its language. The project of scholarship of teaching and learning has highlighted the importance of clearly defining the kinds of thinking students should be expected to do in each disciplinary field. The reason is that each discipline has its own particular “conditions of knowledge” so that successful learning depends upon familiarising students with these cognitive processes as effectively as possible. This becomes particularly important in educational systems where students regularly move between disciplines (Pace 2004). This project seeks to contribute to recent reflections in this area by exploring the experiences of first-year English undergraduates when introduced to historical source work. It reflects upon my own teaching experiences, my observation of students' learning, and assesses the value of a methodological seminar introducing students to some of the key language and practices involved in historical source work. It draws upon student responses to a questionnaire completed after this seminar, a detailed teaching and learning log I completed over the course of the 2013 autumn semester, and students' performance in their mid-term examinations. It argues that a step-by-step practice-based model of learning most effectively consolidated students' theoretical understanding about how to work with historical sources. It explores common student misperceptions about source work and persistent difficulties they displayed in learning how to situate and assess primary sources in their specific historical context. It shows that student learning and performance was most optimised when students were asked to use historical sources to assess a specific historical problem, and suggests the importance of designing document-based studies that offer step-by-step scaffolding for how to read primary and secondary sources alongside each other, to evaluate and cross-reference sources and to draw conclusions based upon wider contextual understanding.

The project sought to explore the following questions:

1. What world views, preconceptions and experiences do English-degree students bring to the classroom that may influence their engagement with historical documents (Pace 2004)?
2. What experiences do students have of historical source work prior to the MEW course?
3. What specific challenges do students exhibit when introduced to historical source work and what particular teaching strategies might help them to develop the historical thinking habits the discipline demands of them?

Methods

Students taking the MEW course in the 2013 autumn semester were the first undergraduates to have a specific lecture and seminar introducing them to some of the theoretical thinking on history methods and practices. This was deliberately placed early on, in week three of the fourteen week course. It was introduced on my initiative as course co-ordinator, following consultation with my two other teaching colleagues, who had longer experience teaching the course and who agreed with my reflections that students needed a more thorough initiation and methodological grounding if they were to develop the historical thinking skills necessary for document-based study. The course is structured into three main teaching components: each week students attend a lecture designed to give an overall introduction to some of the key themes of topics such as the emergence of English in the fourteenth-century; the making of Great Britain and the Caribbean and the Atlantic World. These are followed by student discussions in their reading groups and two-hourly seminars framed around contextual questions that ask students to draw conclusions based upon careful assessment of a range of secondary and primary sources. Previous experience with this teaching and learning model has seen students more able to display critical thinking practices in reference to secondary than primary texts which were often a source of anxiety and uncertainty.

The methods and practices seminar was designed to introduce students to the some of the ways in which professional historians use historical sources and to equip them with some basic strategies to encourage them to assess the range of sources they would encounter in "an historically appropriate way" (Pickles 2011). An important element of the seminar was the opportunity for students to experiment with two different approaches of source assessment; firstly, the study of primary sources to address a specific historical problem (Tosh 2010). This is the model that students usually work with on this course and although designed to guide their assessment, it can limit the "horizon of possibilities" students see in sources (Portelli 1997), all depending on the kinds of questions they ask. I hoped that revisiting sources previously studied in the first two weeks and applying the more nuanced source-oriented approach historians often work with (Tosh 2010) might encourage them to exercise historical curiosity, to identify new ideas, and to make inferences to find new meanings.

The exercise was designed, above all, to familiarise students with historical methodological language, and to develop their confidence in managing the uncertainty that often exists around primary sources. It was also intended to model for students the practices of historical source analysis. Following the seminar I asked the 65 students from my two classes to complete a qualitative questionnaire (appendix A) that asked them to reflect upon their learning experiences. I recorded my own observations of their learning in the teaching and learning log I completed over the course of the semester. I initially intended to follow up this questionnaire with a second survey at the end of the course, asking the students to reflect upon some of the specific skills they had acquired from repeated practise with source-based tasks. However, their very limited responses (16) to the first questionnaire suggested that my own reflections from the weekly log would be more illuminating and that a second-round of questionnaires was unlikely to elicit the considered reflections I sought. The responses to the questionnaire, nonetheless, revealed valuable insights into students' historical thinking, including misperceptions that British and American school children have been shown to exhibit. Some of these misperceptions I saw eroding in the course of later document-based seminars, whilst other analytic skills students continued to struggle to master. The subsequent sections will draw upon my log and students' responses to the questionnaire to reflect upon students' learning in this methodological-framed class. They will suggest what students' responses to the questionnaire tell us about their understanding of historical practice. They will also reflect upon the different teaching strategies I employed in subsequent seminars to address some of the particular difficulties students showed around the documents, and which models worked better than others.

Reflections

Students' experience of historical work: beliefs and misconceptions

The students' response to the questionnaires revealed that most started the MEW course with only limited experience of historical source work. Although 56 per cent recorded that they had 'some experience' of such work (44 per cent had had 'little or no experience'), further responses revealed this was generally limited to some discussion about how to categorise sources, whilst some mentioned they had been introduced to basic techniques for source analysis. The overwhelming majority of this work had occurred in the second and third years of their gymnasium studies, with the exception of one student who recorded they had studied HF History as part of the entry requirements for the BA English degree. However, the minimal details students gave in their answers made it difficult to assess the exact nature of the work they had undertaken. Assessment of students' performance in the close source work undertaken during the first three seminars revealed some awareness about the importance of assessing the reliability of sources, and how this related to author motivation and historical context. However, many struggled to evaluate the documents and to make inferences about possible layers of meaning by drawing upon their contextual understanding of the period. Their observations on the source content of the fourteenth- and sixteenth-century documents remained generalised and unsupported by explanations of appropriate context. The unfamiliar sixteenth-century language and sheer length of William Tyndale's texts also acted as obstacles making the students reluctant to hypothesise meaning. These early sessions highlighted the need to provide students with guidance that would move them away from description – what they saw in the document – to context-specific interpretation – what might this mean and how does it relate to our historical problem?

An important learning objective of the methods and practices seminar was to make students self-conscious about the process of critical thinking when working with historical documents. Learning about the types of questions historians ask of their sources and being able to explain why they do so, meant students learning to understand what it means to think historically. Classroom discussion around these questions, when and why historians might ask them, and what factors might affect the type of questions asked was intended to clarify students' thinking around the theory guiding historical practice. Above all, asking students to consider a range of questions it might be conceivable for historians to ask of their sources was designed to show them the importance of keeping an open mind when approaching historical texts. It was also intended to begin to dissolve the rigid thinking students can sometimes display around historical sources, and to familiarise them with the acceptability of uncertainty when working with sources.

The discussion confirmed research that has shown students often hold set ideas about why certain types of documents are inherently more reliable than others. The importance of assessing a source's reliability was one of the skills students most frequently listed amongst the four the questionnaire asked them to suggest as important for successfully completing the course. In the classroom activity many students chose a diary or testimony as an example of a primary source, and suggested the inherent unreliability of this source on account of its bias. Their rigid thinking around the dangers of using such sources betrayed confusion over how historians actually work. Barton has identified as a potent myth the notion that historians use a "sourcing heuristic" to evaluate bias and reliability. He has argued that such a myth demonstrates a misguided understanding of how historical knowledge is constructed. According to this view historians examine historical sources and consider how far they can be trusted to present accurate accounts of past events (Barton 2005). In their questionnaires students echoed this sense that there was a 'correct' model for 'how to analyse texts historically'; the key to unlocking or 'decoding' meaning depended upon having the 'correct tools' and being a 'smart', 'critical' or 'objective' reader. 'Knowing whether or not [a source was] reliable' was for these students what it meant to think historically.

Such a view perhaps explains why it was that students struggled with the task that asked them to revisit in small groups one previously studied primary source from the course, and to assess it according to a source-oriented approach. Moving around the groups revealed that students were preoccupied with the question of authorship, and that having researched the author's background, the meanings they found in the sources related directly to the author's own individual history. Students' struggled to draw upon their wider contextual knowledge of the period to see different possibilities in the document beyond the authors' own views. An example of this was students' assessments of John of Trevisa's notes on his 1387 translation of Ranulph Higden's *Polychronicon*. In this source Trevisa tells us about the transition of French to English language in fourteenth-century England and how, from 1385, English had become the language of learning for all grammar school children. Many students examining this source focused on debating how far Trevisa could be trusted as a 'reliable' witness to this transition. They drew upon his expressed disapproval of this development to speculate on the possibility that he might have been exaggerating the magnitude of such changes. Yet they did not ask why he might hold his particular view, how representative it may have been amongst men of his religious education, why he was speaking on this question, and what his view tells us about the importance of language and learning for certain sections of late fourteenth-century English society. Students overlooked more subtle possibilities and details contained within the source that also raised questions, for example, about the role of the plague in the language transition.

Modelling source-based practice

The students' performance in the methods and practices seminar and their responses to the follow-up questionnaire illuminated the potential value of a carefully managed, step-by-step approach to source work. It suggested the need for a model of practice that would help the students to visualise the documents in relation to the contextual seminar questions framed around a particular historical problem. Subsequent seminars revealed the difficulty students found in relating their understanding of the general historical context, as absorbed from lectures and individual secondary reading, to the specific views and details the sources expressed. This was notable in the seminar that asked students to assess a selection of primary sources to consider what they told us about when and why the English language won out in eighteenth- and nineteenth-century Ireland, but not the English Protestant religion. Students struggled to make sense of and manage the cross-section of political views the sources represented, and to explain these in the light of their wider knowledge of the historical narrative. They either tried to answer the question in general speculative terms that drew upon their understandings of contemporary social power or made observations about specific viewpoints the sources expressed, but failed to explain these in historically contextually-specific ways. It was not until I spent time visiting the students in their smaller groups and guiding them towards possible meanings by asking further contextual questions that they began to make connections to begin to draw historically informed inferences.

Several students expressed the difficulty of understanding the documents in relation to the wider context they had read and discussed prior to the seminar. Faced with an average of six different primary documents, they needed appropriate scaffolding to begin to relate the sources to the wider context, to cross-reference sources, and to develop more informed, in-depth explanations supported by specific evidential examples drawn from a selection of the sources. This finding supports Peter Frederick's argument that teachers need to model for students how to interpret a historical document by guiding them through a close textual reading. Not only should they use a variety of documents (which this course already did), but they should be brief enough to be visually present in class (Frederick 1999). In this context I discovered one of the obstacles hindering my students' ability to read the sources in relation to each other; in contrast to earlier generations of history students, this cohort no longer had hard copies of the documents laid out in front of them. The students rely on being able to download the documents from the online course page, but this saw few of them annotating the documents and visually drawing comparisons across several documents at any one time. This perhaps suggests the value of the type of online assessment task that has seen American high school students undertaking scaffolded online exercises using digitised primary sources to help integrate acquisition of historical contextual knowledge and historical thinking skills (Tally

& Goldenberg 2005). Yet it also suggests the value of developing document tasks that encourage students to critically assess secondary sources alongside primary ones. This would help to challenge students' misperceptions about the inherent 'trustworthiness' of secondary texts in relation to primary ones, and would teach them to read and understand secondary sources as just as much products of their specific historical context. Above all, it would illuminate the social dialogue historians enter into with their sources and the influence their specific worldview has upon their reading and their approach to particular historical problems. This could be done by incorporating extracts of secondary sources within the document collections we ask students to consider. At present the course sets two secondary chapters or articles as weekly required reading in addition to the primary documents. But by including short secondary extracts as part of a document 'set', students could be encouraged to research and reflect upon the sources' providential details just as they are trained to do with primary sources. Often such details are given immediately above the main text of the primary document, and the guidelines students receive for documentary analysis encourage them to use these as 'an anticipatory framework' for assessing the meaning of the text (Wineburg 1991).

Rarely over the course of the weekly seminars did students show signs of asking why historians drew the conclusions they did. In a seminar framed around the question of why the British chose to establish a settlement in Botany Bay in 1786, the extent of their confusion over historiography became clear. Asked to consider how and why historians' arguments and approaches to this historical problem had changed over time, they were able to give detailed narratives of the shifting arguments. Yet it took a carefully managed question and answer session to guide them towards an understanding of how the changing historical context in which each of the historians had been writing might have shaped the questions they asked and the conclusions they drew. The value of this particular seminar was the way in which it made students conscious of the critical thinking processes historians engage in. Students were asked to study the same collection of primary sources - James Mantra's Proposal, 23 August, 1783; a letter from James Mantra, 23 August, 1783 and Lord Sydney's report to the Lords Commissioners of the Treasury, 18 August, 1786 – from which successive generations of historians had formed their competing arguments. They were asked to find evidence to support or refute each of the main arguments, and to consider whether the issue could be resolved on the basis of the documents alone. The task required them to critically assess the credibility of secondary sources and to give evidential examples to support their arguments. It saw students starting to display the kind of in-depth analytical thinking the discipline demands, and to move beyond the narrative frameworks most had given in their mid-term essays. They now began to engage in a critical dialogue with historians, drawing upon their wider contextual knowledge of the eighteenth-century British Empire and the social, economic and political processes making the Anglo-world. The task encouraged students to move beyond a binary approach to questions of reliability and bias – a source was for either biased or not, reliable or not – to consider some of the more subtle factors shaping subjectivity and historical reasoning. It also alerted them to the layers of possible meaning to be found in individual documents. Whereas students had entered the classroom expressing the implausibility of questioning the views of professionally-trained historians, by the end of the lesson, most had given clear views about which arguments they found most convincing, with historically substantiated reasons why.

Conclusion

This project has reflected upon some of the teaching and learning experiences involved in an introductory history course taken by English degree undergraduates at the University of Copenhagen. It has focused on the particular misperceptions these students held and the challenges they met when asked to perform the kind of historical thinking normally expected of history undergraduates. It highlighted the demands we make of these students when we ask them to critically assess a range of complex primary and secondary sources to find layers of context-specific meaning. Not only must students have a strong grasp of the contemporary English language in order to assemble a narrative understanding of contextual events and historical developments, and to understand the meaning of historians' arguments and ideas. They also need a working knowledge of how meanings of this language have shifted over time and place, if they are to begin to make sense of the complex subjectivities historians bring to a historical problem.

My findings suggest the value of history teachers providing these students with the kind of carefully scaffolded tasks British and American students often work with in post-16 history courses. Although scholars like Barton caution against the artificial construction of 'document-based activity', because it gives students false impressions of how historians actually select and work with documents, at a more sophisticated level source-based activities that ask students to evaluate and assess competing historical interpretations offer much learning potential for non-native English speakers new to the discipline (Barton 2005).

This study will conclude by suggesting some practical guidelines history teachers in the English department might bear in mind when thinking about how to inspire their first-year students, and to foster the kind of higher level historical thinking that fulfils definitions of critical thinking in the arts and humanities:

1. Design document-based activities framed around a specific historical problem that will enable students to assess a range of competing views.
2. Document studies should complement lessons that examine the contexts in which the documents were produced. Students need a firm understanding of the historical narrative before they can begin to make sense of more complex interpretations about particular topics.
3. It is worthwhile introducing students to some of the theoretical thinking around source material and the customs guiding historical practice. This allows opportunities to explore and challenge students' beliefs and misperceptions around historical evidence.
4. Keep source extracts brief and manageable, and encourage students to work in small groups to share ideas, noting down questions to follow up with further research. This also helps to overcome difficulties with meanings of language. Design sub-questions to guide students through the cognitive processes necessary for historically-substantiated reasoning and interpretation. The end of the task should see them beginning to formulate conclusions to the overarching historical question framing the exercise.
5. Include a mixture of primary and secondary source extracts within the selection, and encourage students to research the contexts in which secondary as well as primary sources were produced, and to consider questions of how authorship and motivation might have been shaped by this context. Encourage them to adopt this as a standard practice for all their secondary reading. Exercises which make students more conscious of the relationship between subjectivity, context and narrative, and its implications for historical thinking might be useful here. Peter Frederick starts his history courses by getting students to write a mini biography of another student, based upon individual reflections each student writes and exchanges (Frederick 1999). The activity is designed to give students a taste of what it means to think like a historian, to begin to

make sense of fragmentary sources, the role of selection and interpretation, subjectivity, context and continuity and change over time. Similar activities might be worthwhile in order to excite the enthusiasm of students who sometimes need convincing of the relevance and stimulation to be found in history.

A Questionnaire sent to 65 undergraduates taking the Making of the English Speaking World introductory history course in autumn 2013.

Historical Source Analysis Evaluation

I would like to hear your feedback about how useful you found the teaching on historical source analysis. I would like to know how you have experienced the first two sessions working with the historical documents, and what skills you feel you have learned during this third seminar that might help you during the remainder of the course. Please give honest answers. Your opinions will be treated confidentially and will be used to help improve future teaching on this course. Thank you for your time and effort.

1. What level of experience have you had working with historical sources before taking this course? (Please circle, as appropriate)
   a) A lot of experience
   b) Some experience
   c) Little or no experience

2. If you have previously worked with historical documents, please state when and where you did this. For example, at high school or researching family history.

3. What previous level of experience have you had in studying history? Please state, for example, what grade/year of school you studied history up to.

4. What kind of skills do you think you need in order to successfully complete this course? Please list up to 4 skills.

1.

2.

3.

4.

5. Before the seminar on historical documents, what did you find difficult about working with the documents during the first two weeks of the course (from the medieval period and the 16th century).

6. What did you find good about the teaching in the seminar on historical documents?

1.
2.
3.

7. What would you have liked the teacher to have done differently?

1.
2.
3.

8. Please list what you feel you have learned from the seminar on working with historical documents?

1.
2.
3.

7

Revising a Bachelor Program in Astronomy

Kjartan Münster Kinch

Niels Bohr Institute, University of Copenhagen

Introduction

In early 2014 a committee was formed to evaluate and recommend a revision of the bachelor and master programs for students pursuing studies in astronomy at the Niels Bohr Institute, University of Copenhagen. The work of this committee led - through a somewhat convoluted process - to a new structure for the astronomy-specialization of the physics education at the Niels Bohr Institute. This new structure will be implemented beginning in the fall of 2015. The most important change is the establishment of an introductory/overview class as the first astronomy course in the bachelor program.

In the following I describe the work of this committee and the process that led to the adaptation of its central recommendation. My aim is to present my own qualified reflections as an active committee member, describing loyally the motivations and deliberations of the committee, while also presenting my own perspective from my current privileged position of hindsight. I've been careful to distinguish my personal reflections and opinions from the positions of the committee as a whole. Not because there was much internal disagreement within the committee (indeed there was not), but because other committee members cannot be held responsible for my current reflections and might possibly disagree with some (or all) of them.

My focus here is on the revision of the bachelor program. The committee also reviewed the master program but because the bachelor revision was the first that would be implemented and the master program revision would depend on the new structure of the bachelor program the efforts of the committee were primarily focused on the bachelor program and I've decided to exclusively focus on this aspect of our work.

Specific Background

The Niels Bohr Institute is the physics department at the University of Copenhagen. It is a large department which covers a wide range of physics-related fields. Entering undergraduate students at the Niels Bohr Institute are presented with a choice of 5 specializations at the bachelor level. These are: "pure" physics, astronomy, biophysics, geophysics or meteorology. In addition to the final project, the specializations each consist of 4 mandatory courses, totalling 30 ECTS points, equivalent to half a year of classes. The remaining courses are either mandatory classes shared by students of all specializations or free electives. Thus, our assignment as committee members was to suggest revisions for 4 courses, equivalent to half a year of full-time coursework. In the existing structure the 4 slots were filled with the classes: "Cosmology" (Year 1, Quarter 4), "Galaxies" (Y2Q1), "Planets and Star Formation" (Y2Q3) and "Stellar Structure and Evolution" (Y3Q2).

The committee was essentially self-selected, formed from the people that volunteered at an openly announced introductory meeting. There was 7 members in all with a good coverage of all the sub-fields of astronomy represented at the department. In particular, the two administrative subdivisions of astronomical research at the Niels Bohr Institute the "Dark Cosmology Centre" and the group "Astrophysics and Planetary Science" were evenly represented with 3 committee members and 4 committee members, respectively. All committee members were relatively junior teaching staff or postdocs. One person left during the period to accept a job in the private sector. As a postdoc I was one of the most junior committee members both in terms of academic status, time at the institution and previous teaching experience.

Perspectives from the literature

There is a substantial existing literature on design and implementation of curricula. Several relatively recent books give thorough overviews from a practical (Diamond et al. 2008) or more theoretical perspective (Wolf & Hughes Eds., Lattuca & Stark 2009) while numerous journal papers exploit various aspects in greater detail. Here, I will merely draw attention to a few points that are of particular relevance to our work in the astronomy-review committee.

The word curriculum sometimes refers to detailed planning for a single course performed by a single person or small team; other times it may refer to the higher-level structure of an entire program as planned on the departmental level. Curriculum is more than just content and may be divided into at least 4 parts: content, organisation, teaching and learning methods, and assessment (Knight 2010). One definition views the curriculum as an academic plan (Lattuca & Stark 2009) but others distinguish between the "planned", the "created" and the "understood" curriculum (Knight 2010), which is essentially another way of saying that what we planned in the committee is not likely to correspond perfectly with what teachers will eventually execute which again will not be received by the students exactly as intended. A banal insight, perhaps, but important.

Another way of looking at the components of a curriculum distinguishes between the three *domains* of Knowledge, Action and Self (Barnett et al. 2010). Science-curricula tend to be heavily weighed towards the knowledge domain although there is a general trend towards including more learning activities that focus on what students do and what skills they learn rather than on the knowledge transmitted: elements that can be said to belong in the action domain. This, in part, is in response to modern student-centered pedagogical thought (e.g. (Biggs & Tang 2011)), in part in response to demands from employers for graduates trained in relevant generic skills (Hills et al. 2010). Also, however, this is in response to a very old tension in the teaching of science: the desire to teach students not just the *results* of science but also the scientific method itself. To transform them from acquirers of knowledge into producers of knowledge (Manathunga et al. 2011). In short: to turn students into scientists.

In practice, most curricula have grown by some complex, historical process involving the weighing of many interests against each other. They "evolve by accretion, with new requirements and constraints often layered incompatibly on top of existing structures" (Director et al. 1995). Teaching staff have dual – sometimes conflicting – loyalties to their institution on one hand and to their academic discipline on the other (Barnett et al. 2010). In addition multiple other constituents are invested in the curriculum ranging from students themselves (and their families) to employers and governments. As a result "curricula have tremendous inertia and often resist all but the most incremental of changes" (Director et al. 1995) and when changes happen they may be haphazard, governed as they are by "the constructed, negotiated, contested, provisional and often-complex nature of what happens in departments" (Knight 2010).

In *Designing and Assessing Courses and Curricula* Robert Diamond (Diamond et al. 2008) lays out a detailed method for guiding a process towards curriculum change. Stated very briefly the first 4 steps of this suggested process are:

1. Gather support and assemble the team
2. Gather essential data
3. Think in the ideal
4. Adjust from the ideal to the possible

Under point 1, Diamond underlines the vital importance of broad support before embarking on a project of curricular change. This includes support from management, including adequate time to perform the work, as well as support from the teaching faculty. When it comes to assembling the team to execute such change (such as our committee) Diamond has some interesting suggestions. He advocates strongly for including a facilitator to guide the process and act as devils advocate by challenging assumptions and asking hard questions. A facilitator is usually a person with substantial teaching experience but from a different academic field. Somebody from a department for teaching and learning or pedagogical development can also make a succesful facilitator. In addition Diamond stresses the desirability of including as far as possible the people that will actually teach the courses. Unlike some other workers (Bovill et al. 2011, Bovill 2014) he doesn't advocate giving students real power over this process but he does support including student perspectives as far as possible.

"Essential data" under point 2 in Diamond's process is things like surveys of incoming students and of graduating students as well as statistics of passing rates etc. It also includes formal requirements, existing guidelines from accrediting bodies etc. as well as experience from other institutions and perspectives from the pedagogical literature. Once this is in place the idea of the division in points 3-4 is to begin with a careful, structured brainstorming process and think through carefully, and in some detail, what the ideal solution would look like. Only afterwards should one adjust to what is possible. The point is to not limit the good ideas too early as one will often find that constraints or limitations are not as absolute as initially perceived.

A final perspective, comes from a detailed case study of a dramatic overhaul of the curriculum for the degree in Electrical and Computer Engineering (ECE) at Carnegie Mellon University (Director et al. 1995). This case study from 1995 was very influential and is still highly relevant (Grimson 2010, Ambrose 2013). Believing that "real impact in engineering education will be made only by looking at the curriculum as a whole, in the context of present technological and societal needs, and not just by constant repolishing of aging courses." (Director et al. 1995) the ECE faculty took a "wipe the slate clean" approach, started from the ideal, and thoroughly overhauled their curriculum. The changes were rooted in a number of perceived problems, among them an increased student diversity both in terms of the skills and background of entering students and in terms of the career aspirations of graduating students, a proliferating amount of material to cover and an inflexible existing curriculum making even small changes difficult to implement. The solution was a curriculum with a few, broad, introductory courses followed by a high number of electives for the students to choose freely, subject only to some broad constraints ensuring a certain level of depth and coverage.

Of particular interest in our context is perhaps their argumentation for the establishment of a new freshman introductory course: "The course motivates and introduces basic concepts ... in an integrated manner, provides hands on laboratory experience early, and strives to imbue students with some ability to look at the 'big picture"'. One of the major changes we suggested was the establishment of the course "Introduction to astrophysics" and our motivation for recommending this was almost identical.

Work of the committee: Planning process.

The committee met regularly through the winter and spring of 2014. At the meetings we assigned tasks, discussed work already accomplished and how to proceed, and generally worked to build consensus. After establishing the "boundary conditions" of our problem (i.e. four courses of each 7.5 ECTS points) we quickly decided to approach it by "wiping the slate clean" and imagining the best possible plan. Each committee member was assigned the task to independently conceptualize a set of four courses. When we met and compared notes it turned out that there was a large overlap between our different concepts. In particular, every one of us had planned for some flavor of introductory course as the first course. Some envisioned a more traditional construction or had some emphasis on historical elements, some had particular emphasis on hands-on activities or exposure to current hot research topics, while others again emphasized central concepts with course titles such as “Light and Gravity”. The point remained that all of us wanted the first slot filled with a broad, cross-cutting, introductory course rather than a more narrow disciplinary course.

We had a long list of arguments for beginning with an introductory course:

- To familiarize all students with some basic astronomical concepts that later courses can draw on. Specifically we felt that some basic familiarity with the life cycle of stars would be beneficial for later courses on e.g. galaxies, but a thorough treatment of stars would benefit from being late in the bachelor program when the students knew more fundamental physics.
- To give all students an appreciation for the big picture and a context for more specific later material and to emphasize the unity of central physical concepts and phenomena in astrophysics. As one example disks are found on many scales in astronomy from galaxies to planetary systems to Saturn’s rings.
- To provide a single-class foundation in astrophysics for students pursuing another specialization and to ensure that all students with a bachelor in astrophysics have been exposed at some level to all major areas of astrophysics from cosmology to planets.
- To give students specializing in astrophysics an early contact with the research that happens in the department and to give them basic research-relevant skills (e.g. programming). This will allow them to make an informed choice of early independent research projects and to succeed in such projects.
- To act as advertisement for the astrophysics-specialization and entice more students to seek out this specialization.

While individually the validity of these points may be contested (and indeed were contested by other faculty members), to us in the committee they added up to a compelling case for establishing an introductory course. In my view the case is still convincing.

We conceived the introductory class to be co-taught by several faculty from different branches of astrophysics and to be a mixture of lectures and hands-on exercises. In addition we envisioned each week to include a short guest lecture on a subject of current research interest and relevant to the material covered that week. Since this introductory course was central to our conception of the bachelor program we spent a lot of time drafting quite detailed plans. We drafted plans for the three following courses as well but these were less detailed. In all cases the plans would of course be subject to changes once a lecturer for the given course was identified. Once all these plans were in place we sent them to the wider faculty in astrophysics with a request for feedback and an invitation to a public hearing on the suggested changes.

Work of the committee: Outcome

We received only a limited amount of written feedback before the hearing. The limited detailed feedback we did receive was largely negative. The hearing itself was a well attended and rather contentious affair. Several senior faculty members were quite critical both of our plans and of the way we had organized our work. The criticism concentrated on two main points:

1) People felt that our plans for the introductory course were far too ambitious and that the course was in danger of devolving into a very superficial course filled with "material the students could read themselves in the encyclopedia".
2) We were also criticized for not having done sufficient preparatory work on analysis of the available data on student passing rates, student satisfaction etc. And for not having a clear statement of what we wanted to achieve with the revision: What were our specific success criteria?

This led to some sharp exchanges between committee members and other faculty and in the end the hearing ended up being perhaps less constructive and productive than it might ideally have been.

Over the following months I did some analysis on behalf of the committee aimed at addressing point 2) of the criticism above. We had statistics of student enrolment and passing rates for the four astronomy courses beginning in 2008. These statistics show a substantial variation in number of students signing up for the first course ranging from 28-52. Meanwhile the number of students showing up for the fourth course is remarkably stable, varying only between 15-18. This does on one hand appear to show room for improvement in retention of students through the astronomy-program, in particular, there's a large drop between courses 1 and 2. On the other hand the remarkable stability of enrollment for the fourth course could be interpreted to mean that the actual number of students sufficiently motivated to stick with the astronomy program is hard to change and that the great variability in sign-ups for course 1 rather represents a variable number of students taking this course despite having no intention to specialize in astronomy and/or students that drop out of physics entirely after the first year. The numbers are hard to interpret with confidence.

We did not have surveys of the attitudes of astronomy students going back in time but on short notice we passsed out a questionnaire to students of the astro 1 course in late spring of 2014. This questionnaire had a low response rate (~40%) and so one should be careful about drawing conclusions but it did appear to show 1) that the students were overall quite satisfied with the astro 1 ("Cosmology") course and 2) that students interested in fundamental physics were particularly appreciative of the current astro 1 course while students planning to specialize in astronomy tended to like the idea of a broader introductory course. A later survey of students on the astro 2 course ("Galaxies") appeared to re-enforce these tentative conclusions.

At this point we were in a sense overtaken by events outside our control as the University's implementation of new government reforms ("fremdriftsreformen") moved forwards. We were informed that a new structure for the entire physics education would be implemented with a number of elements that were already decided at the faculty and department administration level with no room for input from us. The new structure still had 4 slots for astronomy courses but they were moved, most significantly there were now no astronomy courses in the first year and the first astronomy course was moved to early in the second year. The timeline for providing course descriptions for the four new astronomy courses was highly compressed (~2 weeks) requiring immediate action from the astronomy faculty.

This lead to a second faculty meeting focused on the implementation of the new course structure. This meeting was quite practical and focused on scrambling to get things in place in time to get a workable program under the new structure. We were able to argue convincingly that our proposed set of courses would fit well under the new structure, the impending substantial changes meant that keeping the status quo of the current course structure was no longer an option, and as the only detailed proposal that was developed enough to have a chance of being ready within the severely constrained timeline we essentially ended up having our proposals accepted by default as the only horse in the race.

Discussion

In light of the literature perspectives outlined above and with hindsight of knowing the outcome, my own current view of the process towards change in the astrophysics curriculum and the work of our committee is mixed.

On one hand I strongly believe that our detailed proposal for a new bachelor program in astrophysics is fundamentally sound and has great potential to lead to a strong and successful program. I find the overall case for an introductory astrophysics course as I've outlined it above to be highly convincing. In the committee we agonized quite a bit over the danger of the introductory course becoming too superficial in nature and the detailed draft plan for the course that we produced is aimed precisely at ensuring the correct balance between depth and breadth. In particular we planned for extended hands-on excercises that would delve more deeply into specific subjects. In light of that I believe that the course can be executed in a way that avoids a superficial, "encyclopedia" treatment of the material. The proof of this will ultimately be in the actual execution.

On the other hand I view the *process* through which we arrived at this result as quite flawed. Partly the flaws lay in choices made by the committee early on, but mostly they were in the construction of the committee and in the some of the fundamental constraints under which we worked. Referring to the steps of method outlined by Diamond (Diamond et al. 2008) of 1) *gather support*, 2) *gather essential data*, 3) *think in the ideal*, 4) *adjust to the possible*, we did well on points 3) and 4) but failed on both 1) and 2).

First of all: Efforts on building of explicit support from faculty and management were lacking. I believe that we should have had an early meeting with astronomy faculty and representatives of management (e.g. vice director for education) present. This meeting should then have assembled the committee, explicitly formulated the scope of its task, and clarified an agreed-upon decision-making process. It never, throughout, became entirely clear to me exactly who had power to decide on whether or not to accept our proposals. Final responsibility rested with department management but they were clearly willing to accept the consensus of the astronomy faculty. How exactly this consensus would emerge, and who would speak for it, was severely unclear.

Secondly: Given enough time, we would have benefited from spending some effort on collecting more information before beginning our work. Even my limited literature search here revealed several interesting ideas. Especially the thought of including a facilitator-type role on the committee is, I think, intriguing. We could have sought guidance from the department of science education or from faculty at other departments with experience of similar processes. We could also have explored the inclusion of student perspectives. There is some thruth to the criticism we received at the hearing: that we should have spent effort on analysing data on student satisfaction, sign-up rates etc. However: we worked under severe time pressure and while to some extent this data was available, doing a really solid analysis would have required substantially more time in order to collect survey data under the existing course structure. Ideally this would have require years of data-collection and some funding for secretarial or student-assistant help in digesting this data. Clearly it would be beneficial to now establish an explicit procedure for collecting and digesting such data under the new course structure in order to have it available at a later date.

Finally, as planners of a limited subset of courses in a larger program we were squeezed uncomfortably between administrative levels "above" and "below" us. The departmental level above required our work to fit into an already specified structure that defined time-slots and what other classes the students would follow while from below we were constrained by the need to leave freedom for as-yet-unspecified teachers to define specifics of the courses we were planning. These constraints together severely restricted our options. The constraint from above affected us very explicitly when the wider curriculum structure changed substantially late in the process. The constraint from below was maybe less explicit but probably more serious.

In hindsight I believe strongly that the question of who would take on the teaching of these 4 bachelor-level courses should have been defined very early in the process and these people should then – if at all possible – have become members of the committee. This would have given the committee far more freedom to go into detail with course planning. As it was we were compelled to focus primarily on content and we left for example the question of assessment entirely unexplored. In addition it would have pre-empted much of the criticism that emerged at our hearing. Much of the resistance we encountered came (understandably, maybe) from faculty members that taught existing bachelor-level courses. If the decision about who would teach the new courses was already taken and accepted such discussions would have been had within the committee, in a smaller, more constructive forum with more time to work out differences.

Conclusion

I was a member of the committee established to evaluate and recommend a revised bachelor program in astrophysics at the Niels Bohr Institute, University of Copenhagen. Here, I've presented my personal reflections of this process. A central recommendation of the committee was the establishment of a cross-cutting introductory astrophysics course as the first course in the program. After a somewhat convoluted process the main recommendations of the committee were accepted and they will be implemented beginning in the fall semester of 2015.

While I strongly believe in the quality of our suggested, revised program I feel that the process leading to that outcome was less than ideal. The committee worked under severe time-pressure, subject to an unclear decision process with a task that was imprecisely defined and with options constrained by administrative levels both above and below. Particular points that could have been improved were:

- The establishment of the committee should have happened via a larger meeting that explicitly expressed support for the work and precisely defined the tasks of the committee and the decision making process. The committee could have included a person with the role of facilitator.
- The committee should have begun its work by gathering information from a variety of sources such as the pedagogical literature, people with experience of similar processes and available quantitative data. A longer period should have been available for this part of the process. Data on student satisfaction with the new program should be collected beginning now.
- Early on the staff that would teach the 4 bachelor courses should have been defined and these people should have been part of the committee. This would have allowed the committee to go into more detail with planning of the courses and to more confidently adress issues beyond content such as teaching and learning methods and assessment

Ultimately the proof of our work will be in the performance of the new program beginning in the fall of 2015. No doubt there is substantial work still to be done by teaching staff in the detailed planning of courses and no doubt the courses will evolve over the coming years. I am confident that the new program will be successful in attracting and retaining students, in giving students from other branches of physics a good basic insight in astrrophysics, and in producing specialized graduates with a solid grounding in astrophysics.

8

Evaluating the use of a student response system in high enrollment anatomy lectures

Svend Sparre Geertsen

Department of Nutrition, Exercise and Sports & Department of Neuroscience and Pharmacology, University of Copenhagen

Abstract

Student response systems[1] (SRS) are devices or software that allow students to provide responses to questions embedded within a lecture, which can then be automatically summarized to provide immediate feedback to the students and/or teachers (Wieman 2008, Mathiasen 2013, Vicens 2013).

I recently used an SRS, Shakespeak®, for my lectures in Anatomy in the course Exercise Physiology 1 at the Department of Nutrition, Exercise and Sports, University of Copenhagen. Anatomy lectures are often thought to be dull and full of details and difficult names, and with 136 students in the course it can be challenging to engage and interact with the students. The aim of this project was to evaluate the use of Shakespeak® based on student feedback from a questionnaire and a focus group interview.

Questionnaire results showed that 99% of respondent liked the quizzes, while 88% thought that they helped them to remember the content of the lectures. About 55% believed that the quizzes influenced how they studied after a lecture and 72% felt better prepared for the exam. Qualitative analyses of the students' open-ended responses in the questionnaire and comments from the focus group interview provided support and additional insights for the quantitative analyses.

Overall, the Shakespeak® quizzes were popular with the students, and they made the course more engaging and motivating. The quizzes helped

[1] The literature uses many names for these devices or systems, such as "Clickers", "Electronic Voting Systems", "Audience Paced Feedback" etc.

the students to retain information and prepare them for the exam, and the students wished that they would also be used in courses other than just Anatomy.

Introduction

Most textbooks claim that students learn by actively processing the information (Biggs & Tang 2011). Nevertheless, the most common form of teaching in University settings, lectures, are often criticized for leaving the students as passive recipients of knowledge and being too tedious to sustain students' attention. But is it at all possible to activate students in lectures with a high enrollment? I was recently faced with this challenge, as I was assigned a weekly 2-hour anatomy lecture for the first year students in the course Exercise Physiology 1 – a course with approximately 140 students.

To deal with this challenge, I first interviewed a focus group of second year students, who had taken the course the previous year, about the use of and challenges with student-activating activities in large classes both in general and in this course specifically[2]. The main points were that the students want to (and expect to) be activated in lectures[3], but that the main barrier for their participation is fear of embarrassment. Towards the end of the focus group interview, we introduced them to the use of Shakespeak® quizzes to overcome these barriers. Shakespeak® is a web- and SMS-based SRS that can be used as a pedagogical tool to activate students in the lecture hall. The teacher can pose a question and immediately see the students' responses[4]. The students respond, anonymously, via SMS, Internet or Twitter.

As the feedback from the focus group was very positive, I decided to explore the use of Shakespeak® quizzes in my lectures in Exercise Physiology 1. I typically exposed the students to a total of 4-6 quiz questions during a 2-hour lecture in 2-3 sessions with 1-3 questions in a row. A quiz session about the topic of the previous week was usually placed in the beginning of the lecture to repeat important points (3rd & Butler 2011). Sometimes a

[2] This was performed as part of our Universitetspædagogikum pre-project

[3] "The more things I need to think about – the more I feel I learn." Comment from student C in the focus group interview

[4] Shakespeak® is integrated into PowerPoint® and the distribution of answers automatically pops up on the following slide

session was placed mid-way if the topic was particularly difficult to comprehend or if I did not have other breaks or activities to sustain the students' attention (Dahl & Troelsen 2013). There was always a session at the end of the lecture to sum up the main points. Types of questions used included both simple recall of lecture points (figure 8.1) and tests of conceptual understanding. The quizzes involved both simple votes and 'think-pair-share' where students were first given time to think on their own, then invited to pair with a neighbor to discuss their reasoning and finally asked to vote. This structure was inspired by the literature on the use of SRSs (Beatty et al. 2006, Caldwell 2007, Wieman 2008, Vicens 2013) and tailored to fit the intended learning outcomes of the course.

Fig. 8.1. An example of a simple recall Shakespeak® question (left) and distribution of the 119 votes in the following slide (right). This was asked in the very first Anatomy lecture. When vote distributions like these appeared, students were often asked to discuss with their peers after which the vote would be repeated.

The aim of the present project was to evaluate the use of Shakespeak® quizzes in these lectures through student feedback. More specifically:

- Did they like the quizzes and if so, why?
- Did the quizzes influence how they studied before and after lectures? And what they remembered from lectures?
- Did they feel that the quizzes better prepared them for the exam?

Methods

To address these questions, at the end of the course I asked the students to fill out an anonymous, electronic questionnaire consisting of 10 questions and an open-ended comment box (see Appendix A for questions in Danish). The students received an email with a link to the questionnaire the day before the last lecture and were asked to respond within a week. For question 3-8, the students were asked to rate how much they agreed with the statement on a scale from 1 to 5 (1 = strongly disagree, 5 = strongly agree). For simplicity reasons, ratings of 1 and 2 are interpreted as disagree, 3 as neutral and 4 and 5 as agree. In order to supplement the quantitative feedback from the questionnaire with qualitative feedback, I conducted a 60-min focus group interview with 7 students from the course. The interview was recorded simultaneously on a video camera and on an iPhone 4 with the Voice Memos application. After the interview, all comments from the focus group were typed in to an excel spreadsheet. I did not attempt to quantify the responses, but have quoted some of the representative comments in the text. Some of the interview questions were based on the results of the questionnaire, e.g. "In the questionnaire, 99% respond that they like the quizzes. Can you explain what you like about them? What type of questions do you prefer?" Other questions were directed more towards their preparation, e.g. "*Did the Shakespeak quizzes influence how you prepared [before a lecture]? How?*" The focus group questions are summarized in Appendix B (in Danish). All questions and comments from students were originally in Danish, and have only been translated to English when used in this paper.

Results

Out of the 136 students following the course, 97 responded before the deadline. Figure 2 shows that 92% of the respondents attended all or nearly all of the anatomy lectures (5 or 6 of the 2-hour lectures), which indicates that they have regularly been exposed to the Shakespeak® quizzes.

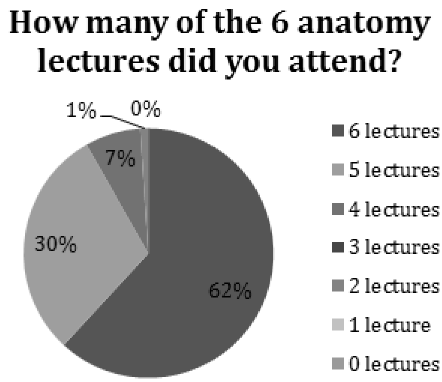


Fig. 8.2. Number of lectures attended by the respondents (n = 97).

(Figure 8.3) gives an overview of the responses to the questions where the students had to rate how strongly they disagreed or agreed with the statement. For 84% of the students it was the first time that they had tried SRS quizzes (data not shown) and 99% agreed that they liked the Shakespeak quizzes while 88% agreed that it helped them to remember the content of the lecture.

An open-ended comment from a student supports this view: "*A really good way to activate a whole lecture hall! It can often be difficult to stay focused, but if you are given a task to reflect about the content of the lecture it improves learning, at least in my case. Keep up the good work*!"

Another student commented: "*The quizzes made the lectures more alive, and engaged us much more than regular lectures. A superb initiative.*"

Questions: 1 = strongly disagree 5 = strongly agree	1	2	3	4	5	Average
I liked the Shakespeak quizzes	0%	0%	1%	13%	86%	**4.8**
The Shakespeak quizzes helped me remember the content of the lecture	0%	2%	10%	37%	51%	**4.4**
The Shakespeak quizzes influenced how I studied (e.g. what I focused on) after a lecture	4%	14%	26%	35%	20%	**3.5**
The Shakespeak quizzes made me feel better prepared for the exam	3%	3%	21%	37%	35%	**4.0**
I wish that Shakespeak quizzes would also be used in lectures in other courses than anatomy	0%	3%	10%	42%	44%	**4.7**

Fig. 8.3. Distribution of responses (n = 97) to the questions where the students had to rate how much they agreed or disagreed with the statements on a scale from 1 to 5 (1 = strongly disagree, 5 = strongly agree).

An often heavily debated point is student preparation. From the questionnaire it appears that 57% of students study for all or nearly all lectures, whereas 15% prepare only a few times or never (figure 3), but I was curious to see if Shakespeak® quizzes might have influenced how the students prepared for the lectures. I therefore asked the focus group: "*Did the Shakespeak quizzes influence how you prepared [before a lecture]? How?*"

There was a general agreement that the quizzes did not directly influence how they studied for a lecture, although student E commented that it might affect him subconsciously: "*...but subconsciously. I want to study for this lecture because I know that it doesn't bore me to death, because you actually become involved and have to decide on something.*" However, student G commented that: "I think it has a bigger effect on how you study after a lecture than before," which everyone in the focus group then agreed with.

Indeed, 55% of questionnaire respondents agreed that the quizzes influenced how they studied after a lecture (figure 8.3). Comments from the focus group indicated that it helped them to focus their reading after lectures. This was both in terms of what was important, but also in that it gave them feedback on what they had understood and what they needed to focus more on. Student A: "*...and if you don't get it right, you think, at least I do, then I HAVE go home [and study] and it HAS to be there tomorrow.*"

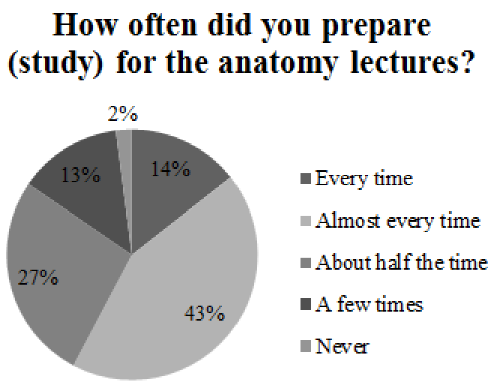


Fig. 8.4. Pie chart showing how often students prepared for anatomy lectures (n = 97).

What about the amount of questions during a lecture? Since this was my first time using Shakespeak® quizzes during lectures I was not sure about how many questions to ask during a lecture. Just under half of the respondents (47%) would have liked more questions whereas the rest (53%) thought that the amount was appropriate. No students responded that they would have liked fewer questions (data not shown). Comments from the focus group was mainly in favor of 'appropriate', and some said that more questions would have taken too much time away from the rest of the lecture, and that there is always a bit of noise after a quiz.

Discussion

It has previously been shown that SRSs can increase the engagement, motivation and learning in high enrollment chemistry lectures (Hall et al. 2005). Many students in this study also mentioned increased motivation, engagement and retention of information, as some of the positive effects of Shakespeak® quizzes. From the focus group, student G said: "*It creates a motivation to stay focused and it makes it easier to remember afterwards.*" And an open-ended comment from the questionnaire stated: "*Keep using it. It works really well and it is fun! The students wake up and participate in the* *teaching and it is nice to get feedback on whether you have understood it correctly. Big fan* :)"

Another student commented: "*Shakespeak demanded that you, as a student, had to be active during lectures, which created a more dynamic learning environment. Lectures are usually experienced as passive learning for the student, which is often de-motivating.*" There is no doubt that by activating students with a question, several good things happen. It focuses the students' attention on the important facts or ideas and it allows students to try applying the ideas that they just heard or read about. According to student comments, questions with peer discussion before voting seem to be especially effective in this: "Excellent tool. Good when the students stick their heads together and discuss. Then you typically remember what was discussed. Great tool and good lectures." This has also been indicated in former studies (Kristensen 2012).

Another study evaluating the use of SRSs at 8 different departments over the course of two years with group sizes of 12-300 students found that across disciplines benefits outweigh disadvantages (Draper & Brown 2004). Improvements in attendance has also been observed in previous studies (Caldwell 2007) and although it is not possible to conclude if the attendance rate was influenced by the use of Shakespeak® in the present study it is impressive that 92% of respondents attended all or nearly all lectures.

It is remarkable that 72% replied that the quizzes made them feel better prepared for the exam. Here it is important to keep in mind that the course, Exercise Physiology 1, ends with a multiple choice questions (MCQ) exam, which resembles the format of the quizzes that I have used in my lectures[5] and is therefore nicely aligned. In a study by Roediger (2008), it was shown that retrieval practice is of critical importance for the consolidation of learning. After learning foreign vocabulary words, students that were repeatedly tested without further studying had a large positive effect on delayed recall, which was not observed in students that repeatedly studied the vocabulary items without further testing (Roediger 2008). Although one might argue that 'recall' belongs at the bottom of the SOLO-taxonomy (Biggs & Tang 2011), recalling (naming) is still part of the learning objectives in anatomy. While difficult to compare, it is interesting that the results of the anatomy part of the final exam showed that the students scored $67 \pm 14\%$ (mean $\pm$

[5] An important difference is that Shakespeak® allows only one correct answer whereas the final exam can have up to 5 correct answers to each question

SD), which is significantly better than the score of $45 \pm 19\%$ in the previous year ($P < 0.001$). It is impossible to determine if the Shakespeak® quizzes contributed to this difference, as the exam questions were not the same and because many other changes were also introduced to the course. Nevertheless, it is something that should be investigated in future studies.

Deep learning also requires the active processing of information, and a passive reading of material or knowledge transfer through teacher monologue is simply not enough. I believe that Shakespeak quizzes can provide a helpful tool to engage the students in this process. In support of this, 86% wished that Shakespeak quizzes would also be used in lectures in courses other than just Anatomy. How could Shakespeak® quizzes then be organized in courses that use different types of final exams to allow for constructive alignment? I recently taught the course Exercise Physiology 2 that ends with an oral exam. In those lectures, I always instructed the students to discuss with their peers before voting and emphasized the importance of this, as they would soon have to argue their points at the exam.

Conclusions and perspectives

Overall, students liked the Shakespeak® quizzes and found that they made the course more engaging and motivating, and helped them to remember the content of the lectures. The quizzes did generally not affect how they studied before a lecture, but 55% indicated that it influenced how they studied after a lecture, and 72% stated that it made them feel better prepared for the exam. While exam results were significantly better than the previous year, future studies should specifically investigate if SRSs can contribute to improved student performance in Anatomy. The Nobel Prize winning author, Albert Camus, once said: "*Some people talk in their sleep. Lecturers talk while other people sleep.*" I believe that SRSs like Shakespeak® can help with the second part of the quote and should therefore be used in lectures to sustain students' attention and help them to actively process the information to increase learning.

A Questionnaire used for evaluation of the use of Shakespeak in Exercise Physiology 1

2/8/2014 Shakespeak quiz-spørgsmål i forelæsninger

Shakespeak quiz-spørgsmål i forelæsninger

Kære studerende.
Jeg skal til at skrive min afsluttende opgave i Universitetspædagogikum og håber I vil hjælpe mig ved at udfylde dette spørgeskema (10 spørgsmål) om brugen af Shakespeak quiz-spørgsmål i anatomi-forelæsningerne i Arbejdsfysiologi 1. Jeg vil bruge jeres svar til opgaven, men også til at forbedre dette og andre kurser fremover.
Jeres svar er anonyme.

Anatomi-forelæsningerne generelt

1) Hvor mange af de 6 anatomi-forelæsninger i Arbejdsfysiologi 1 har du været til?
(hvis du er i tvivl, så markér det antal du tror)

- ○ 0 forelæsninger (ingen af forelæsningerne)
- ○ 1 forelæsning
- ○ 2 forelæsninger
- ○ 3 forelæsninger
- ○ 4 forelæsninger
- ○ 5 forelæsninger
- ○ 6 forelæsninger (alle forelæsninger)

2) Hvor ofte forberedte du dig inden anatomi-forelæsningerne?
(fx ved at læse foreslået litteratur/pensum)

- ○ Hver gang
- ○ Næsten hver gang
- ○ Ca. halvdelen af gangene
- ○ Nogle få gange
- ○ Aldrig

3) Forelæsningerne i anatomi har bidraget til min læring i kurset
(markér det tal mellem 1 og 5, som angiver hvor enig du er i ovenstående udsagn)

	1	2	3	4	5	
Slet ikke	○	○	○	○	○	I høj grad

Shakespeak quiz-spørgsmål

4) Jeg kunne lide Shakespeak quizzerne
(markér det tal mellem 1 og 5, som angiver hvor enig du er i ovenstående udsagn)

	1	2	3	4	5	
Slet ikke	○	○	○	○	○	I høj grad

https://docs.google.com/forms/d/1OQlDtw9kb1W-m-lDHbTElcuOSAOehAHT8AOgloYYg08/viewform 1/3

5) Shakespeak quizzerne gjorde at jeg bedre huskede det der blev forelæst om
(markér det tal mellem 1 og 5, som angiver hvor enig du er i ovenstående udsagn)

	1	2	3	4	5	
Slet ikke	◯	◯	◯	◯	◯	I høj grad

6) Shakespeak quizzerne havde inflydelse på hvordan jeg læste (fx hvad jeg fokuserede på) efter en forelæsning
(markér det tal mellem 1 og 5, som angiver hvor enig du er i ovenstående udsagn)

	1	2	3	4	5	
Slet ikke	◯	◯	◯	◯	◯	I høj grad

7) Shakespeak quizzerne gjorde at jeg følte mig bedre forberedt til eksamen
(markér det tal mellem 1 og 5, som angiver hvor enig du er i ovenstående udsagn)

	1	2	3	4	5	
Slet ikke	◯	◯	◯	◯	◯	I høj grad

8) Jeg synes at antallet af Shakespeak quiz-spørgsmål i forelæsningerne var:
(markér det svar der passer bedst med ovenstående udsagn)

◯ For få (jeg vil gerne have haft flere)

◯ Passende

◯ For mange (jeg ville gerne have haft færre)

9) Jeg ville ønske at Shakespeak quizzer også blev brugt i forelæsninger i andre fag end anatomi
(markér det tal mellem 1 og 5, som angiver hvor enig du er i ovenstående udsagn)

	1	2	3	4	5	
Slet ikke	◯	◯	◯	◯	◯	I høj grad

10) I anatomi-forelæsningerne i Arbejdsfysiologi 1 var det første gang jeg prøvede quiz-spørgsmål med anonyme, elektroniske stemme-systemer (som fx Shakespeak og Clickers) i forelæsninger

◯ Ja

◯ Nej

Kommentarer og/eller gode råd til brugen af Shakespeak i forelæsninger?

2/8/2014 Shakespeak quiz-spørgsmål i forelæsninger

Tusind tak for din deltagelse :)

Submit

Never submit passwords through Google Forms.

Powered by Google Drive

This content is neither created nor endorsed by Google.

Report Abuse - Terms of Service - Additional Terms

B Summary of questions used in the focus group interview

1. **Opvarmning:** Vil I på skift introducere jer selv
2. Hvad var jeres oplevelse af anatomi-forelæsningerne i kurset?
    a. Hvad var godt?
    b. Hvad synes I kunne være bedre?
3. I spørgeskemaet svarer 99% af jer, at I kan lide Shakespeak quizzerne. Kan I sætte nogle ord på hvad I kan lide ved dem?
    a. Hvilke typer af spørgsmål kan I bedst lide?
    b. Hvilke typer af spørgsmål får I mest ud af?
    c. Hvordan tror I det påvirkede jeres udbytte af forelæsningerne?
4. Hvordan forberedte I jer typisk inden en forelæsning i anatomi?
    a. Havde Shakespeak quizzerne indflydelse på hvordan I forberedte jer?
        i. Hvordan?
    b. Hvad med efter en forelæsning. Hvordan læste I der?
        i. Havde Shakespeak quizzerne indflydelse på det?
    c. Tror I at I ville forberede jer anderledes før og efter, hvis der var mange flere quiz-spørgsmål i forelæsningerne?
        i. Hvordan?
        ii. Hvorfor?
5. Gjorde Shakespeak quizzerne at I blev mere klar på, hvad der forventedes af jer rent fagligt?
    a. Og ift. forventninger til niveauet ved eksamen?
6. Mange undervisere taler om, at bærbare og smartphones bliver brugt til ikke-faglige aktiviteter (fx facebook) under forelæsningerne.
    a. Oplever I at Shakespeak får jer til at fokusere mere på det faglige indhold og væk fra de ikke-faglige sysler (facebook m.m.)?
7. Brugen af Shakespeak quizzer tager tid væk fra resten af stoffet. Hvad er jeres holdning til det?
    a. Er det et problem?
        i. Hvorfor/hvorfor ikke?
8. I denne blok bliver der ikke stillet så mange MC quiz spørgsmål, men i stedet bruges message funktionen. Hvad er jeres holdning til det?
    a. Hvordan synes I at formen kunne optimeres i denne blok (når det er mundtlig eksamen)?
9. Har I yderligere kommentarer?

10. **Forelæsningen som en mere aktiv undervisningsform:** Traditionelt set betragtes forelæsningen som en passiv undervisningsform, hvor den studerende "kan slappe af" og lære ved at lytte og notere. Der kan derfor hurtigt opstå en forventning fra de studerende om, at han/hun kan være passiv, hvor clicker-formen er aktiv og involverende.
    a. Er de studerende omstillingsparate og klar til at tage det skift sammen med dig som underviser?

9

When fear takes over: A case study of ELT in Danish higher education

Elke Susanne Greifeneder

Det Informationsvidenskabelige Akademi, Faculty of Humanities, University of Copenhagen

Introduction

English language teaching (ELT) is a reality in Danish universities. Since the European Ministers of Education signed the Bologna Declaration in 1999, the amount of ELT in higher education has risen considerably. While the Bologna Declaration primarily aimed at facilitating exchange, universities quickly realized that an increased internationalization invites a wider set of candidates – both on students' as well as on researchers' level – resulting in higher research excellence. As a result, at the University of Copenhagen, today, 37 per cent of faculty members are non-Danish researchers and most of their teaching is in English.

A university, however, is not a language school. Students are speakers and not learners of English. The primary focus of classroom teaching should be on content and not on form (Björkman 2011). As long as language learning is not an explicitly stated intended learning outcome, the English language is considered to be a tool and not a goal in itself (Ljosland 2011).

Yet if proficiency in English language is not a learning outcome, then it should not influence students' learning and in particular not their grades. Thus this paper examines if there is an influence of ELT on students' learning, and if yes, how this influence is manifested. Based on Ljosland's (2011) findings, the paper hypothesizes that there is a split between students: on the one hand, there are students who have a neutral attitude to ELT, maybe even perceive it as an unexpected learning outcome; on the other hand, there are students who perceive ELT as a barrier to their learning outcome. In the latter group, ELT would affect students' learning considerably.

Related Research

The Nordic countries are considered to be perfect candidates for ELT, because these students possess a "near-native speaker level they have acquired in secondary education and through the wide exposure to the English language in everyday life characteristic" (Shaw et al. 2008, pp. 269) and thus ELT should have fewer or no influence on learning. Yet when asked in a Danish 5^{th} semester bachelor class at the University of Copenhagen, only 50 per cent of the Danish students rated their level of English as fluent, while 15 per cent said they had problems speaking English, 11 per cent had problems writing English and 18 per cent did not feel comfortable with English at all (more details on the class follows below).

Research shows that ELT indeed can have an influence on learning. Tatzl (2011) provided evidence that ELT can be a barrier to participation in class and de Cillia & Schweiger (2001) showed that student's objections against English teaching are linked to a fear of not being able to cope with the content. This is supported by Hellekjær (2010) who found that students had difficulties taking notes while listening to lectures. In an English taught classroom, students adopt a more passive classroom behavior that could be a barrier to their learning outcome (Airey & Linder 2006, Tange 2011).

Ljosland (2011) reported from interviews with students at a Norwegian University about the introduction of English in the curricula and summarized the different ways student reacted to ELT:

> "The students displayed mixed reactions to the language of instruction becoming English. Some were positive, explaining that the opportunity to develop their language skills in addition to the main contents of the course was an added bonus for them. Some were neutral, saying that most of the course literature and much of the instruction [...] normally would be in English anyway [...] Some of the Norwegian students, however, were negative, worrying that their post-graduate theses or their exam answers would not be as good as they could have been had they been allowed to write in their mother tongue" (Ljosland 2011, pp. 998).

In order to prevent this kind of split in attitudes between students, teachers need to know why this split occurs in the first place. Stephen Krashen's

Theory of Second Language Acquisition (1982) provides one possible answer (figure 9.1). Krashen assumes that every comprehensible input, in this case every English word spoken by a teacher or a fellow student, runs through an affective filter.

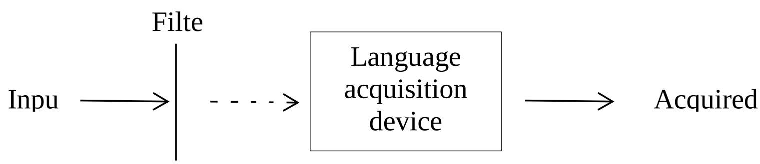


Fig. 9.1. Operation of the affective filter as proposed by Krashen (1982).

This filter functions as a screen and "is influenced by emotional variables that can prevent learning. This hypothetical filter does not impact acquisition directly but rather prevents input from reaching the language acquisition part of the brain"[1]. The affective filter can be prompted by different variables such as anxiety, self-confidence, motivation or stress.

Good ELT must therefore aim at preventing the occurrence of affective filters such as anxiety, low-self-esteem or stress. The classroom should be a safe and welcoming environment, in which language mistakes do not matter and in which students can take risks. When students need language skills for course completion, teaching and learning activities need to combine content with language mediation. This can be in form of English reading material, of peer assessment or in-class group-discussions in English. Teachers can also be sympathetic in grading, meaning that "students are given credit for demonstrating understanding even if their ability to express their understanding in clear and accurate English is limited"[2].

---

[1] Bilash 2011: online source: http://www.educ.ualberta.ca/staff/olenka.bilash/best%20of%20bilash/krashen.html , accessed 26 July 2014

[2] Shoebottom 2013: online source: http://esl.fis.edu/teachers/support/faq1.htm, accessed 26 July 2014.

Methodology

This paper presents a case study of a Bachelor course on the 5th semester with English as teaching language. The course took place in the fall 2013 at the Royal School of Library and Information Science at the University of Copenhagen and the theme of the course was information behavior and interactive spaces. The school makes no special provisions for facilitating language learning through English for Specific Purposes courses. A total of 81 students (26 males and 55 females) took part in the course and submitted a written assignment, which was graded.

The course was co-taught between a Danish professor, teaching in Danish, and a German assistant professor, who taught in English. The students had to complete two assignments: a first short assignment of 2300 words, in which students had to analyze given interview material and write a short article in English showcasing their capacity of analyzing empirical data and relating it to theory. The second assignment counted more and was considerably longer. It could be submitted in Danish. Because the second Danish assignment was graded by a different teacher and was a group-work as required by the study regulations, statistically valid comparison of the two assignments was not possible. Yet, the aim of this research was not to compare the two assignments, but to uncover issues with ELT as described below in student's feedback.

25 of the 81 students had had teaching in English on the 2nd semester by a male colleague from the Netherlands. The students in his course were allowed to write the course assignment in Danish, though. All other students have never been exposed to ELT during their university studies. For all students, the assignment was the first assignment they had to write in English.

Before the start of the semester, the form of assessment and the teaching and learning activities were redesigned to be constructively aligned (Biggs & Tang 2011), especially to a context in which the exam language is English. The activities aimed at reducing students' fear of writing an assignment in English.

A few days after submission of the English assignment, a mid-term evaluation was performed in class. A second, end-of-term, evaluation was performed after students had received their grades for the English assignment. All evaluations were performed in class, on paper and used open questions. No question specifically asked about ELT and English assignment writing. Instead, the survey asked what they had liked about the teaching and what should be improved. This approach avoided asking directly for comments on the ELT. All comments reported are therefore comments students felt the need to say, because it was in some way important to them.

Results

The teaching and learning activities
Teaching and learning activities were designed to help students accomplish the first English assignment – both in terms of content as well as in terms of English writing. The teaching was dialog-based and made heavy use of group-work. Students were encouraged to participate, in English, but were also allowed to ask the teacher questions in Danish (and having a fellow student help translating) and to speak Danish in the group-work. Students were repeatedly told that the classroom is a safe place to discuss content and that content matters and not language. The teacher also emphasized that the course was about the course's topic and was not a language course. Many students took an active role in the dialog-based teaching; yet it was also possible to hide and not to speak English and thus not make use of the safe training environment.

For the course, students had to read a total of 600 pages, of which most were in English. Through the intensive reading of materials in English on the course topics, students were able to learn the content specific vocabulary – at least in a passive way.

The readings included for example two articles that both made use of interview data examining the same topic (with different results). In class, students participated in a learning activity in which they had to analyze these articles and find out what sections the articles have (introduction, method, results, discussion and conclusion) and what they should write in each section. By this approach, students both learnt what their assignment should look like, and also the vocabulary used in English empirical articles. In a second activity, the students analyzed how the two different authors presented their interview materials (as direct quotes or by paraphrasing). Again, this activity aimed at showing how English articles are structured and also how the students can present interview data themselves.

Students were also invited actively to train their writing. For example, students were asked to submit a self-written abstract of an article, which was intentionally deleted from one of the course's readings. Submitted abstracts were then individually corrected by the teacher and students received a written feedback on the correctness of the content of the abstract. They also received feedback on how they could improve their written English. All students were told that the teacher's comments are just suggestions for improvement and that they do not need to worry about their English language. Students who showed a low command of English were told the same, but were also encouraged to find a peer and read each other's assignments. All abstracts were graded for internal purposes.

Two weeks before final submission, students were invited to write one page of their assignment and bring it to class. In class, students were randomly assigned to peers and had time to read the one page and give each other feedback. During this time, the teacher quickly scanned all one-page-trials and gave individual feedback at the end of the class. At this stage, feedback was entirely on content and the teacher used the above mentioned approach of sympathetic reading and blinded out all language issues.

Relationship between grade and English language command

Despite the various efforts on the teacher's side, the difference in grades between students whose English writing skills were weak and those with high command of the language was troubling. All assignments were graded by two independent researchers (the German teacher and an external Danish censor) with the above mentioned sympathetic intent, meaning language did not matter as long as the content was understandable and the data analysis and the argumentation was convincing. Grading was performed on the Danish 7 grading scale (A = 12, B = 10, C = 7, D = 4, E = 02 Fx = 00 (failed) and F = -3 (failed)). For the purpose of this analysis, the teacher internally rated the English in all assignments using three simple categories: weak command of English, good command and excellent command.

A Kruskal-Wallis Test revealed a statistically significant difference in grades across the three different language skills groups (weak command, $n = 33$; good command, $n = 35$; excellent, $n = 13$) $p < .01$. The student group with the weakest command of English received a much lower average grade ($M = 5.03$) than students in the other two groups (good command of English $M = 8.23$ and excellent command of English $M = 10.08$).

Other influencing factors were examined, but no further statistically significant differences between groups could be found. There was no evidence of a difference between genders (Mann Whitney U Test, $p = .789$) and no evidence of a difference between students who had previously attended a class with English as teaching language and students who were first-timers in an ELT class (Mann Whitney U Test, $p = .065$). Also a regular attendance in class did not statistically influence the average grade (Mann Whitney U Test, $p = .225$) and the submission or not-submission of an abstract as part of the homework did not result in a statistically significant difference in grades between the groups (Mann Whitney U Test $p = .109$).

Of those who had submitted an abstract as homework, 63 per cent of the students received a similar (internal) grade for the abstract than they did for the final assignment and equally 18.4 per cent received a better or a worse grade than the grade that was given internally for the abstracts. This means that the activity of writing an abstract might not significantly help to improve student's grade average, but the short one paragraph homework appears to be a good predicator of the grade of the final assignment. Teachers could make more effective use of this indicator and offer more targeted help, especially for those students who run low in scores.

While submitting the abstract homework had no significant influence on the average grade, it had a small effect on the command of English language writing. All abstracts were internally rated as weak command, good command and excellent command and from the 38 students who had submitted an abstract as homework, 71.1 per cent showed a similar command of English in the final assignment. Since the boundaries between good and excellent English were sometimes hard to define, a good command in the abstract homework and an excellent command of English in the assignment counted as similar level and vice versa. A real step from weak to good or excellent command of English language made 18.4 per cent of the students, while only 3 students (7.9 per cent) showed a lower command of English in the assignment than in the abstract.

Student feedback and evaluations In order to further explore the influence of ELT on students' learning, two written evaluations and one oral feedback session were conducted. 56 students completed the first, mid-term, evaluation a few days after submitting the assignment; 46 students completed a final, end-of-course evaluation that is after they had received the grade. The latter evaluation was in Danish; the first one was in English. The questions in the two evaluations were slightly different with the first one asking about what students liked and did not like about the teaching and the second one (the official university evaluation) what was good and not so good, what they found rewarding for their learning and what did not support their learning. A last question in the second evaluation asked students to name three things they learnt in the course. In addition to the two written evaluations, 46 students received an oral ten minutes feedback from the teacher on their assignment. The results of these feedback sessions are presented below[3].

The split between students' attitude towards ELT that Ljosland (2011) discussed was clearly visible in the present case. There was one group who had a very positive attitude towards ELT. These students described the experience as "a good challenge", "a good exercise", as exciting ("spændende og udfordrende") or even as "immensely engaging". They said that they were actually glad to have ELT, because it improved their language skills ("Jeg har været glad for undervisningen på engelsk, da det helt personligt styrkede mine sprogkundskaber"). Without explicitly being asking for a comment on the ELT, about 20 per cent of all students in the mid-term evaluation wanted to make a positive comment on the ELT. In the end-of-term evaluation, 11 per cent offered a comment how they experienced ELT as positive. The lower number might be explained by the fact that students were less positive after having received their grades or that the ELT was less dominantly in their mind after a few weeks of Danish teaching since the last evaluation.

A second group acknowledged that they had doubts about the ELT in the beginning, but that they had actually learned something. This means, without being asked if the teaching and learning activities helped them to complete the assignment, students' evaluation comments strongly suggest a constructive alignment of the two. Students commented that it was "a good learning experience", that they "got better", that it was "a good training" and that it was hard at the beginning, but got easier ("I starten var det svært /forvirrende med engelsk undervisning, men det er blevet lettere"). One student commented that "there was a challenge in the whole ´write-in-English‘ thing, but [he/she] was actually surprised at how smooth it went when [he/she] got used to it" and another one said that "at first it was quite difficult to remember how to write in English, but it was very giving during the process". In total, in the mid-term evaluation 16 per cent of students

[3] Some students did not take part in any of the evaluations; other students attended the sessions when evaluations where carried out and did not submit an evaluation. The latter makes it difficult to judge how many students did actually take part in only one of the two evaluations. 13 students, who attended the first evaluation session, were absent in the second evaluation session and 18 students who did not take part in the first evaluation were participants in the second evaluation session. 43 students attended both sessions. It can be concluded, that while the two evaluation groups are not identical, the majority of participants participated in both evaluations.

who commented on the ELT made a statement on their learning progress. In the end-of-term evaluation, 15 per cent commented on their learning progress. In 28 per cent of all submitted end-of-term evaluation sheets, students ranked having a better command of English as one of their three most important things they have learnt in that class. Students said that their English has clearly improved ("Mine engelskkundskaber er klart forbedret"), that they are better writing in English ("bedre til engelske formulering") and that they actually know now that they are capable of writing an assignment in English ("at jeg rent faktisk kan skrive en opgave på engelsk").

There is a third group who displayed a more negative attitude towards ELT with no obvious signs of a positive learning progress. Students commented that they were not so confident in English "and was thus not able to participate as much in class as [they] would like to have". Students in this group said that it was "a bit hard [and] demanded extra time", that it was "difficult", "quite difficult", or even "very difficult". This group also uses the term challenge as the first positive group did, but these students use the term in a negatively experienced way like "writing in English proved quite a challenge" or "it was a challenge [because] it makes the process much harder". Yet level of difficulty and challenges do not explain the significant difference between good and weak command of English and the grades entirely. The assignments, which received low grades, lacked proper introductions, clear research statements; they missed the points between problem statement and analysis or conducted no data analysis at all. None of these elements are directly linked to language writing. Some of the students who received a low grade told the teacher in the oral feedback that they usually receive better grades. Additional comments from the evaluations reveal what might be the reason behind student's failures. Students commented that they did not like that the assignment was in English, because it "made [her/him] very unsure about the assignment". Another stated that he/she had "the fear of misunderstanding something, because of the language". When they learned that the class was to take place in English "it came as a shock for many of [them]". Speaking and writing in English was a large barrier for them ("var en stor barriere"; "en klar barriere") and the English assignment was experienced as stressful ("den engelskopgave var virklig stressende"). Around 20 per cent of the students offered a comment that falls under this group, both in the mid-term and end-of-term-evaluation.

ELT is not only considered as being difficult for the students in this last group. As a female student of the third group explained it in the oral feedback session the act of writing the assignment in English stressed her so much that she focused entirely on language and forgot everything about how to write an academic paper. Students were afraid, that they were mentally blocked. The affective filter, postulated by Krashen, came to full force. Students mentally blocked any logical reasoning, and in doing so forgot basic academic writing. One student was even so desperate that he/she copied the whole assignment from another student and therefore committed fraud.

What can teachers do when this fear takes over? While the teaching and learning activities seemed to have worked for many students, they were not effective for the students who fall under the last category. The latter show a behavior that might be best compared to oral exam fear. If the behavior is similar, then just more ELT will not help these students, because more oral exams do not make people feel less panicked in oral exams. Yet, this is exactly what many departments suggest: offer more ELT and students will get used to it. It is also unclear if English for specific purposes courses will help to reduce the panic. The best teaching solution might be to facilitate success stories: with every success story the fear may slowly fade away. Group-assignment-writing might support this aim. Teaching must seek to provide these success stories.

Conclusion

This paper described the influence of ELT on students' grades and how this influence is manifested. Students were part of a 5th semester Bachelor course taught at the University of Copenhagen and were confronted to English assignment writing. A grading approach was applied in which the grade depended entirely on student's understanding of the material and not on the correct use of language. The results showed that language does matter – institutions should not introduce teaching and learning in English and act as if nothing has changed.

Despite the grading system there was a statistically significant difference between students whose language command was rated as weak and those who possessed a good or excellent command of English. Written evaluations and oral feedback sessions revealed that there exist three groups of students of which one had a positive attitude towards ELT from the beginning and another one that saw the ELT as a positive learning experience. The third group differed fundamentally from the first two groups and showed signs of panic, fear and stress caused by the ELT, which resulted in worse grades.

Good teaching and learning activities should offer challenges for the first group, enable the learning progress of the second group and reduce the fear of the third group students. If the fear takes over, even the best, interactive and inspiring teaching will be inept in the assignment writing phase.

10

Flipped Learning in Organic Chemistry for Life Sciences – Experiences and Considerations

Kenneth T. Kongstad

Department of Drug Design and Pharmacology, University of Copenhagen

Background

*Organic Chemistry for Life Sciences*is a 1st year course at the Faculty of Life Sciences, aiming at introducing key aspects of organic chemistry including chemical reactions, physiochemical properties and metabolic pathways. The course has approximately 200 course participants and as always in these big lectures, there is a risk that students sit with unanswered questions which they do not dare ask – this can particularly be the case for 1st year courses. I got involved in this course with the purpose of developing short 'essentials of' videos supporting the first 8 lectures as these make up a large part of the foundation for understanding organic chemistry. Another name for distributing educational video material is *vodcasting* which is a key part of the concept of flipped classroom. Although I have not had the opportunity to implement this educational technique, I will in the future build upon my experiences with development of video material with the aim of flipping my lectures. Thus, this will be the emphasis of this project.

Introduction to the concept of 'Flipped Classroom'

The flipped classroom is a teaching model developed with the purpose of optimizing the student-outcome of the face-to-face time with the teacher. Jonathan Bergmann, one of the founders of the flipped classroom, explains the *flip* as 'moving the direct instructions from the group to the individual space'. In practical terms, the flip means that the classroom/homework paradigm is “flipped”. What used to be classwork (the “lecture”) is done at home via teacher-created videos and what used to be homework (assigned problems) is now done in class. Besides freeing up class time for students to engage in hands-on learning, collaboration with peers and being guided rather than instructed by the teacher, the flip also introduces a shift from passive to active learning to focus on the higher order thinking skills such as analysis, synthesis and evaluation (Bloom taxonomy).

Another huge benefit of the flipped classroom is the possibility to personalize the lectures. In the flipped classroom, all students can see the lecture in the pace that suits them, and review difficult parts if necessary. This means that the ‘A students’ will not be bored and hence inactive during class time (as could be the case in the traditional lectures) while the struggling students will not give up due to too high pace. In the classroom, the time is then devoted to guide and educate at the level they are currently on.

There are evidently many benefits from flipped learning but it is a big leap from traditional lecturing. To get some experiences with vodcasts to build upon in the future, I used the ‘essentials of’-videos to try out different forms of presentation and through interviews evaluate what is good and what is not

Vodcasting in Organic Chemistry for Life Sciences – my experiences

Below I have summarized some of the general considerations behind the production of the vodcast made for Organic Chemistry for Life Sciences

- With the videos I aimed at presenting one essential subject from each lecture. These subjects were chosen based on my own experience and through discussions with the lecturer.
- As the videos were not meant to replace the lecture, but rather to complement it through going further into details, I decided not to upload the videos before the lecture. This would also give me the possibility to change subject if the lecture showed this to be nessecary.
- I speculated that through engagement of the students (volunteers) in the production of the video material I would be able to transfer ownership of the vodcasts and through this facilitate learning at a higher level.
- I tried different presentation forms: Powerpoint, blackboard-type presentation, pen-and-paper, and cartoon-like presentations. This would al-

low me to evaluate the efficiency of the different formats from both the student and teachers point-of-view.

At the first lecture given in the course, I asked for volunteers for participation in producing the educational videos – this however proved to be more difficult than expected as only 3 students were willing to assist. Having a focus group, I had planned to interview the students after a lecture to verify that the selected topics were indeed the ones causing trouble. This, however, was omitted as I found it unrealistic that the students had time for this as well.

Production

Before going into a discussion about the outcome of the video material I would like to discuss how the videos were produced and distributed. As already described, I had selected 4 different forms of presentation which I will go through individually in the following. Please refer to Appendix A for examples.

<u>Powerpoint:</u> Microsoft has since Microsoft Office 2010 (PC) and Powerpoint 2011 (Mac) included an option to record a slideshow with narration and save this as a video to be distributed. This is very straight forward and it really lets you as a producer perfectly time your slides and narration in a professional way. For flipping your lectures – which you most likely already have as powerpoint presentations – this is a simple and efficient way of doing it. However, the clear cut presentations – which works very well for short videos – tends to lack the aura of personality I would like to have in my lectures. Jonathan Bergmann recommends a tool called screencast-o-matic (http://www.screencst-o-matic.com) from where one can record a desired section of your screen (or whole screen) together with audio *and* webcam. In addition, screencast-o-matic does not limit you to powerpoint but allows you to change to other programs while recording. The online version of the tool is highly intuitive and allows for direct upload to e.g., your Youtube account but lacks the ability to edit the video. Both approaches to convert powerpoints presentations to video material is easy and fast.

<u>Blackboard:</u> Blackboard videos are very simple to record as all it requires is a camera or smartphone. I imagined that this would be an obvious student activity why I let the three students be in charge of this video under

my supervision. It, however, became clear that if you want to produce a video with at proper audio quality you either need a very good camera, a microphone connected to the camera or, as we ended up doing due to hardware issues, add the soundtrack after recording through video editing. If one has the hardware available, the blackboard video is an easy way of making engaging teaching videos – especially for the experienced lecturer. A big pitfall with blackboard videos is that the lecturer potentially speaks for 30-45 minutes on camera without the natural breaks for questions and small exercises which you normally have in traditional lectures. A way of ensuring a high degree of engagement in these types of videos is to engage into a discussion with a colleague rather than traditional lecturing. This has successfully been done by Jonathan Bergmann and Aaron Sams and was also the approach used in the video produced for Organic Chemistry for Life Sciences.

Pen-and-paper: Recording pen-strokes against a piece of paper – be it analog or digital – can be perceived as a combination of a blackboard lecture and a powerpoint presentation. Recording writing on a piece of paper can prove difficult with a fixed camera, which make the digital pen-and-paper the most obvious choice. Digital pens require some training but can be quickly mastered and also allows for making notes on prepared material such as textbook figures when recording with e.g., screen-o-matic. While I find that this presentation form might not be suitable for 30 minute lectures (even though it is often done by experienced flipped teachers such as Jonathan Bergmann) it has great potential for shorter, instructive videos such as spectral interpretation/problem solving for which I used it.

Cartoons: Cartoon based teaching videos can be highly engaging and dynamic but are also time-consuming to create. The cartoon type video I find least time consuming to make (unless you are a skilled cartoonist) is based on cutout drawings which can be combined and moved around on a table, recording only the drawings and your hands. All that is required is paper, pens, and a camera on a tripod. From my experience, the raw footage requires a great deal of editing and thus it is practically impossible to record narration along with the video. Due to the labor intensiveness of this presentation form I find it unlikely that it can be used for long lectures. It could, however, be of valuable use together with other presentation forms such as the blackboard or powerpoint to create variation in these.

Distribution: When spending time on producing vodcasts one should make sure that the material also reaches the students. Internet access should not be a limiting factor, as it was when the flipped classroom was introduced in 2007, so I started out by using the course website. Hosting the videos on the university servers would ensure full ownership of the videos as well as circumvent possible copyright problems when using e.g., textbook figures and sharing videos publicly. It quickly became clear that the university was not geared to handle this kind of material so I opted for youtube (hidden with the need for direct links to handle copyright) with a lot of added benefits such as ability to annotate videos, review usage statistics, and engage in dialogue in the comments section. When new videos were uploaded, it was posted on the course webpage, but during the evaluation I found that to be able to reach the students one should consider facebook or other social network sites used at that particular university.

Outcome of videos

To evaluate the produced material I conducted an interview with volunteer students. Again it proved to be difficult to get the students engaged so the feedback is based on the students who had also volunteered for creating the video material – I asked them therefor to get opinions from their friends prior to the interview. From this it was clear that the most important parameter for an engaging video is that it is not static. This meant, as I had expected, that the powerpoint presentations were the least inspiring videos. The cartoon and blackboard videos were more entertaining and engaging and were, according to the students, better. When asked if they felt they learned more from the entertaining videos they were unsure. Based on the feedback I have received throughout the course, the videos which were most helpful were interestingly enough powerpoint-based, indicating that this is not the case.

While I also find the powerpoint presentation less entertaining than the other formats I believe that this is a highly suitable technique for making vodcasts – both in terms of time-consumption and dissemination. What this has shown me is that to adapt to the flipped classroom methodology one should preferably use a combination of different presentation techniques. This could be executed in a way so that the backbone of the lecture is made up of powerpoint slides – preferably with webcam video embedded for a personalized touch – where the more ‘entertaining’ presentation forms can be used throughout the video present key subjects or for instructional purposes. This not only introduces a variation in the vodcasts but also allow for adaption of the powerpoint part from year to year while re-using the small, more time-consuming video segments.

Considerations for future implementation of Flipped Classroom

I have no doubt that the flipped classroom teaching style introduces many advantages over the traditional lectures – for both teachers and students. Some of the most important being that the students can follow the lectures in the pace that suits them – with the possibility to revisit a given lecture if needed – and that it frees up time in the classroom for student activation which can facilitate higher learning such as analysis and evaluation. For the teacher, I find that the biggest benefit is that you can use your face-to-face time guiding and helping on an individual level.

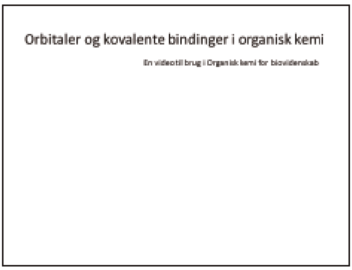
The Flipped classroom was originally introduced at High School level and for successfully adapting it to my teaching at University of Copenhagen, and I believe that several things have to be considered. *First of all*, to implement flipped classroom I think that it is imperative that the entire course is flipped to make the teaching style consistent. If this is not possible for various reasons, the use of 'essentials of'-videos is an alternative which allows the students to revisit particular subject (or get it explained in an alternative way to the textbook if made available before the lecture) but it does not free up time for student activation in the classroom. *Secondly*, in high school, lessons are often in a timespan of around two hours while with the block structure at the University of Copenhagen, the course days are much longer which, with reasonable course planning, should allow for several student activities besides lectures. These longer days might even result in the need for very long lectures/vodcasts to cover all the material for such a day. Based on my experience from this project it could potentially be difficult to keep the students attentive to a vodcast this long resulting in ill-prepared students and hence sub-optimal classroom sessions. For me, the key would be to make short (about 30 min) vodcasts covering only essential subjects which, together with the reading material, would prepare the students for more engaging classroom activities which in turn prepares for the more traditional problem solving. Vodcasts leads me to the *third consideration*: time consumption. This project has shown me that students prefer dynamic, 'fun' vodcasts while as a teacher, none of the presentation styles

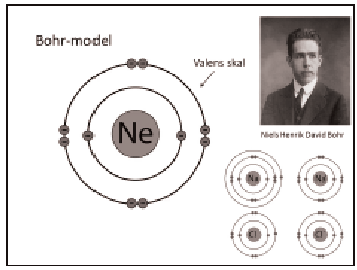
I have tried in this project can compete with the static powerpoint presentation in terms of time consumption and presentation of several subjects. Thus, as mentioned earlier, combining the static and dynamic presentation styles are key to having the best ratio between time and benefit.

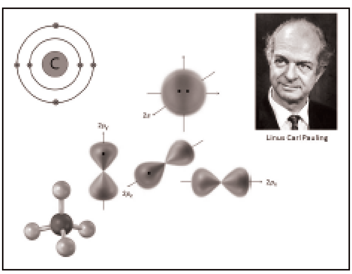
Even though the transition from traditional to flipped learning requires careful considerations and is initially labor intensive, I believe that the benefits gained fully outweighs this. Thus, I am convinced that flipped learning will become more widely used in the universities in the future.

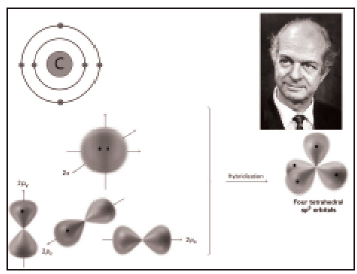
A Screenshots from videos to exemplify the different vodcasts.

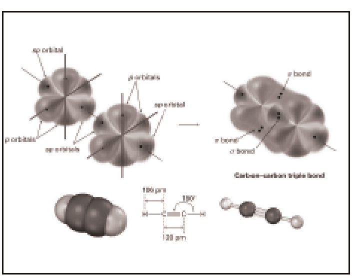
Essentials Of Orbitals - Powerpoint

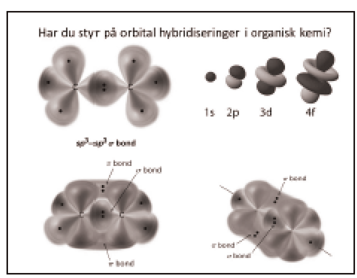




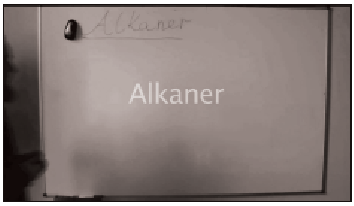


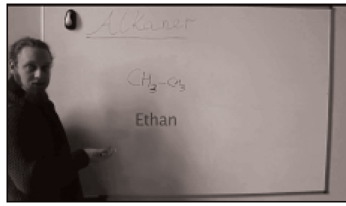


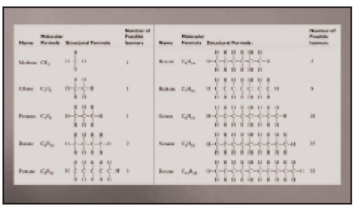


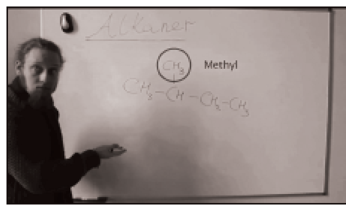


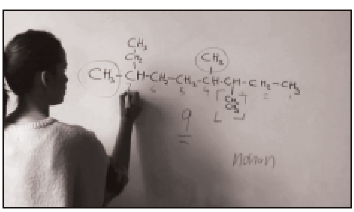
Essentials Of Alkanes - Blackboard

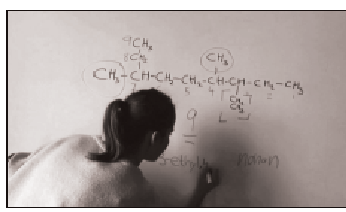


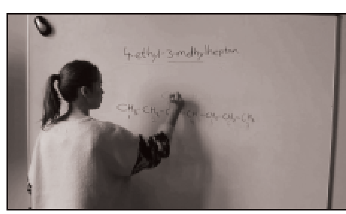




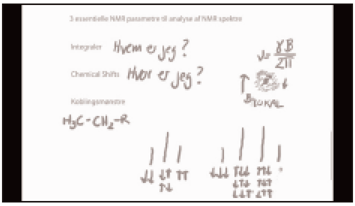


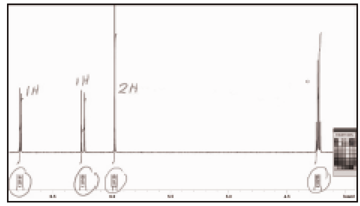


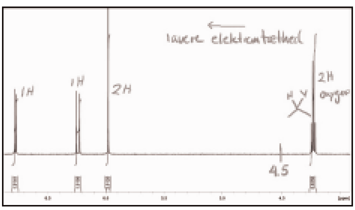


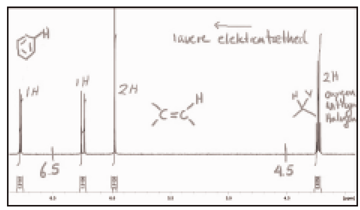


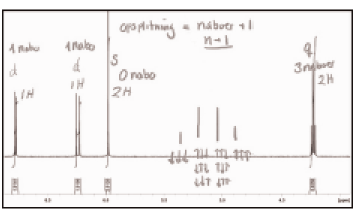
Essentials Of NMR 2 - Pen-and-paper

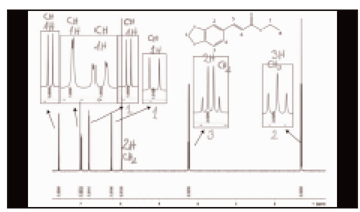


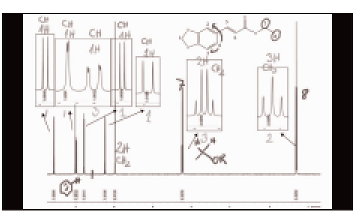


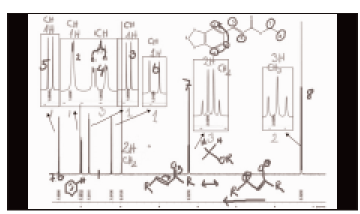












Part III

Stimulating student activity and deep learning

11

Stimulation of deep learning and active participation of students during long and context rich lectures

Karla Kristine Freude

Department of Clinical Veterinary Medicine and Animal Science, University of Copenhagen

Introduction

Learning can be divided mainly into three approaches surface learning, deep learning and strategic learning. Apparently, the latter would be the most preferable approach every teacher would like their students to use.

Surface learning is an approach in which the students focus on the memorization of facts, which they consider to be relevant for the examination. Students try to pass with minimal efforts but best results regarding their grades. This kind of approach can be depended on several factors including for example extracurricular activities, which interfere with the amount of time which can be spend on learning for particular classes, anxiety and misinterpretation of the intended learning goals (ILOs) (Biggs & Tang 2011). This type of learning is more or less superficial and does not enable the students to understand the topic in a meaningful way.

Deep learning involves critical evaluation of the learned content and connection to previous knowledge. This approach thereby enables the students to process the information in a holistic way. Research has shown that using this learning approach results in long term retention of concepts (Bransford, Brown, and Cocking, 2000).

Strategic learning is basically a combination of surface and deep learning depending on time constrictions or large amount of information, which needs to be learned. If this approach is well in sync with deep learning it can be very efficient and productive (Burton et al., 2009).

Even though the deep learning approach is clearly the preferred form of learning some study fields require the memorization of certain terms and facts in order to be able to communicate and reflect on the subjects. One example for this is Anatomy in the field of veterinary and human medical science. One of the challenges of teaching anatomy is clearly the amount of terms, which need to be memorized and correctly attributed to certain organs and tissues. Learning theses terms is similar to learning the vocabulary of a language which needs to be learned. This kind of memorization of terms and facts is sometimes considered in a negative way with the surface approach of learning, but especially in medical and veterinary sciences it is an important stepping stone in order to achieve deeper learning by being able to connect these different body parts in a functional meaningful way and understand the importance of each puzzle piece of the body. This combination of learning facts and subsequently combing these in a meaningful way with function has been described earlier by Entwistle and Entwistle, 2003.

Nevertheless, it is important that learning in this particular field does not stop at the level of memorizing facts, but that a deeper learning approach is achieved as well by connecting the terms in a holistic functionally relevant way.

Aim

The aim of this project was to activate the students in terminology dense lectures and activate deep learning by linking terminology with function.

Course description

The course is a bachelor course for students studying animal science. The general aim of the course is to give broad overview over animal anatomy and physiology, with an emphasis on linking the structures of the body (anatomy) with the function of the body (physiology). Furthermore, students should be able to compare functional and anatomical differences between species. The variety of animals covered are mammals with a focus on farm animals including pigs, sheep, cows and horses; pets including dogs and cats; poultry, fish and exotic species like crocodiles and turtles

It is noteworthy that anatomy and physiology is taught by different departments and different instructors/lecturers. I will elaborate on potential problems with this later in the discussion part.

The course is divided into lectures and practicals, which cover the lectures content and where the students can dissect and observe the anatomical features of the different animal species.

Specific topics to be covered are:

- Anatomy and physiology of the muscular and skeletal system
- Anatomy and physiology of the circulation system
- Anatomy and physiology of the immune system
- Anatomy and physiology of the nervous system
- Anatomy and physiology of the digestive system
- Anatomy and physiology of the respirations system
- Anatomy and physiology of the skin and skin organs system
- Anatomy and physiology of the muscular and skeletal system
- Anatomy and physiology of the excretions system
- Anatomy and physiology of the reproductive system
- Anatomy and physiology of the fish and shellfish
- Anatomy and physiology of poultry

I have taught the lectures and practicals in anatomy for the nervous system and for the skin and skin organs. This project focuses on comparing different styles of lecturing. One of the biggest challenges was to deliver the amount of information in a format to the students, so they had a chance to process and understand the matter. More precisely it is very important, in order to meet the requirements for passing the course, to be able to connect the anatomical observations in a meaningful way with the function of the organ systems and the whole body.

Moreover, I am not a trained veterinarian, so I was also a bit out of my comfort zone even though I have learned zoology during my training as a biologist. Nevertheless, in the end this turned out to be an advantage since the other lecturers are veterinarians and have difficulties in scaling down the amount of taught details and expectations giving the fact that this was a course for animal science students on not for veterinary students. I will elaborate on this later in the discussion part.

Implementation:

1. The first lecture had duration of 4 hours in total covering the brain, spinal cord, the function of afferent and efferent signaling, as well as parasympathetic and sympathetic nervous system. I had access to the lecture of the previous year, in order to ensure that all the important facts will be covered. It was a huge amount of very detailed information, which was clearly more relevant for veterinary students. Since there was so much to cover I did not implement many student exercises during the lecture and gave a more frontal lecture with a few questions and breaks. Problematic was also that most of the material was dealing with the human brain as an example and I think it would be much more suitable to include several animal brains. Especially since we had a 4 hour practical the next day, where it was possible to re-discuss anatomical and functional matters directly having the animal specimen in front us.

2. During the 2^{nd} 3 hour lecture, which was covering the skin and the skin organs, I have implemented several student exercises where the students received a question regarding the just lectured content. They were encouraged to form little groups discuss the questions and come up with a group formulated answer. This lecture was also followed the next day by a 3 hour practical session looking at skin and skin organs in several species. For this lecture I had no insight into the previous year lecture and I only identified the anatomically and physiologically relevant topics myself, with ample of animal disease related examples.

After giving these two lectures I have handed out a questionnaire in order to inquire, which of the lecturing styles was the preferred one by the students, and if the exercises helped to stimulate deeper learning and better understanding of the topic.

Results

The questionnaire consisted of 4 short questions.

1. When you compare the lecture about the brain with the lecture about the skin, which one was more informative to you?

This question was aimed to identify if the students were able to process the information in a meaningful way and if they could handle large amount of facts or if less facts with more functional explanations were easier to digest and memorize able. This was meant to be as an indication if a deep learning process can be stimulated and which form of lecture is more successful for this aim.

2. For both lectures what did you think about the level of complexity?

   <u>Brain:</u>
   - Just right
   - Too complex
   - Not enough information

   <u>Skin:</u>
   - Just right
   - Too complex
   - Not enough information

   With this multiple choice question I wanted to estimate what level of terms and information the students are able to process in such a long lecture situation.

3. Do you prefer frontal lectures or do you like to have more breaks in form of student exercises?
   With this question I wanted to find out if the students find these exercises useful or if they actually prefer being simply told the facts.

4. If you have suggestions how to improve the learning outcome of the class please list them below.
   Here I wanted to see if the students have any other ideas or have experienced learning methods elsewhere which they considered helpful in order to achieve deep learning.

There were a total of 45 students enrolled in this class out of these 7 returned the questionnaires, which gives me a written feedback and possibility to discuss the project on the basis of 15% of students. This can clearly only provide a trend, since it cannot be excluded that the remaining students which did not participate have a completely different opinion.

Results for question 1:

All students agree that the lecture on the skin and skin organs was more informative. This lecture was less terminology dense and had more student interaction in form of exercises. Three students pointed out that the brain and CNS is a difficult and complex topic in general. One student wished for more structure in the CNS/brain lecture, like he/she experienced in the skin lecture.

In conclusion the CNS and brain lecture was too terminology dense and complex. It clearly needs to be restructured for the next year, but more intriguingly it also showed that the student exercises in the skin lecture clearly helped in understanding the topic and digesting the just learned matters. Therefore, it is inevitable that more student exercises are needed, combined with less complexity and clear outline of functional meaning.

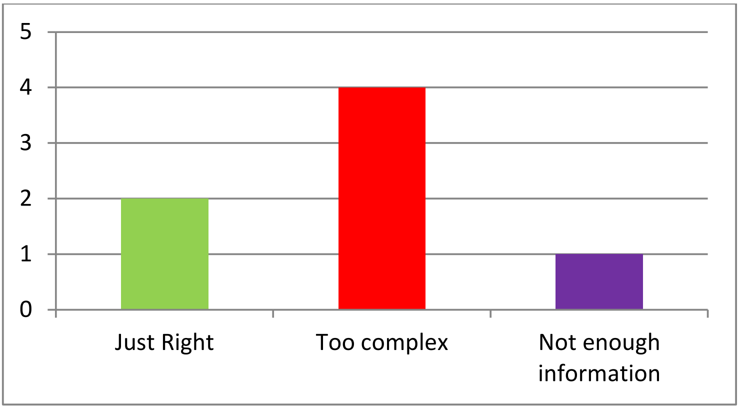
Results for question 2:

The results can be seen in figure 11.1. These results clearly show again that the preferred mode of lecturing is the less complex one with more student exercises.

Results for question 3:

Six out of the seven students, which returned the questionnaire, replied that they like the breaks in form of student exercises. One student mentioned that it is good for recapitulation of the lectured topic, as long as the correct answers are clearly shown at the end. For the sake of clarity I will therefore include an answer slide, which will be developed during the discussion with the students in the next year. Interestingly, two out of the seven students stated that even though they liked the student exercises, they do not want too many interruptions of the lectures caused by these exercises. This is in contrast to another student, who clearly indicated that more student exercises would be helpful in order to process the learned facts. Obviously, this is not a totally surprising discrepancy, since the level of basis knowledge and motivation to read up on the lecture topic beforehand varies amongst students. To be able to draw a clear conclusion here the end numbers of students, which had returned their questionnaire needs to be higher.

Brain:



Skin

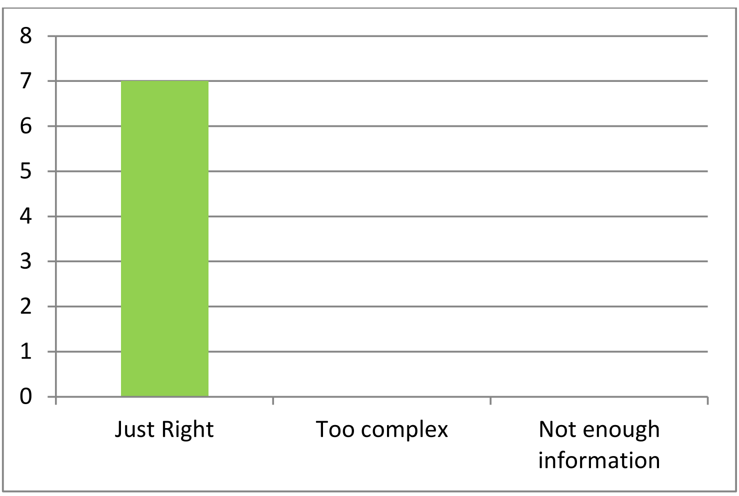


Fig. 11.1. Results for question 2.

Results for question 4:

Question four was more intended to pick the students brains if they have any ideas of alternative methods in order to involve them more in the lecture, or if they have experienced some student exercises in other classes, which have helped them to apply a deep approach of learning towards the lectured topics. Only two students had further comments on this. Both suggested the use of clickers to answer questions. I had considered this mode of student interactions, but I have opted out for two reasons. Firstly, I wanted to focus on the student exercises in small groups and secondly have I decided that the discussion amongst peers would stimulate a deeper learning approach better than simply clicking yes or no. One of the exercises I did was labeling all the different layers of the skin. Interestingly, this was one of the exercises which the students liked a lot even though I was a bit concerned that it is too simple since I just covered every single layer minutes before. Another point was that the students want more student involvement and more time for discussions, which clearly needs to be taken in consideration.

Discussion:

Firstly I have to say that this project was bit tricky, since I never have taught this class before. Moreover, I am not a trained veterinarian since I have studied biology. Therefore, I will also discuss some other observations I made during this class, which are not only strictly considering the two lecture styles and the issues with triggering the deep learning approach.

One of the biggest problems, but clearly the most important intended learning outcome is a meaningful combination of anatomy (structure) with function (physiology). These two clearly naturally intermingled teaching blocks are completely separated and covered by different departments and lecturers. Much to my surprise, was there little exchange or knowledge about the teaching between the departments. It became very clear that much more cross-departmental planning and discussion needs to be initiated for the next year.

Based on these starting conditions it was quite difficult to decide which amount of detail needs to be presented to the students and which are the most relevant functional events to focus on. Another factor of unnecessary confusion of the course was the language issue. The students have several books which are recommended as a basis for the class. These are both Danish and English books. Problematically the students decide themselves which book appears to be more relevant to them, resulting in different terminology and depth of topics described in the books. According to my fellow instructors the students are allowed to use either Danish, English or Latin nomenclature. This was extremely confusing for the students, but for me as well. Especially in the practical sessions students approached me repeatedly and asked what are these structures are called in the other languages. They were very concerned about which terminology to use. It appears like this is an avoidable confusion, which makes the class more difficult to the students.

On the other hand a very positive attribute of the class was the combination of lectures followed by practical exercises the next day. This concept worked very well and the majority of the students were very intrigued by having the biological specimens in their own hands and the possibility to reflect upon the facts they have learned earlier in the lecture. This is clearly one of the strong parts of the course which induces deeper learning approaches.

The lecture part in the previous year was designed as frontal lectures with very little student interaction and it was very terminology rich. This was most likely caused by the fact that this master's class in animal science is novel and had been started in 2012. Most of the lecturers teach the veterinary students and have therefore used the lectures which are aimed at veterinary students for the animal science students. In conclusion the level of lectures is too detailed and terminology heavy. In general this raises also the question if a lecture like this is enough for the students to engage in deep learning approaches or if simply reading the text books would have the same effect. Therefore, I have decided to compare the frontal lecture approach with little to no student involvement to a lecture involving the students via exercises and group discussions. I have interrupted the lecture with three 15 minute student exercises. The questions were discussed in small groups during these exercises and presented in form of a group answers in the end. The questionnaire showed that the students overall preferred having these interactive exercises, which is not entirely surprising since it as anticipated that with more interaction and discussion of the topic a deeper understanding and ownership of it is stimulated.

Conclusion:

Student exercises clearly stimulate a deeper learning approach by actively thinking and discussing the topic. This also transfers a sense of ownership to the learned subject, which in turn leads to a positive attitude towards the learned topic.

Despite of student involvement it became also very clear to me that less is sometimes more. It is better that the students understand the most relevant topics in depth than being able to reproduce terminology without the holistic view of the subject.

Finally, it is also very important for the lecturer to keep things as simple as possible. “If you cannot explain it simply, you do not understand it well enough” (Albert Einstein).

12

Innovation processes as a method to facilitate deep-learning?

Peter Nejsum

Department for Veterinary Disease Biology, University of Copenhagen

Background

Innovation. During the recent years, innovation has become increasingly important to the political agenda and has now also reached the universities. Repeatedly, we are told that if Denmark should manage the ever increasing global competition we should strengthen our knowledge level and our abilities to be innovative. As an example, the University of Copenhagen does now have a section for Research & Innovation with 30+ employees and a new appointed professor with focus on innovation. Furthermore, the University has created a blog called ‘innovation and entrepreneur ship in education’ which provides an array of inspiration, ideas and methods that can be used in teaching. But can this also be relevant from a learning perspective?

Different approaches to learning. Surface learners are focusing on memorizing what they think they are supposed to know in order to pass the exam, which therefore normally only includes the lower level of Bloom et al. (1956) taxonomy or the uni-structural category in the SOLO-taxonomy (Biggs & Collis 1982). In contrast, deep learners are students that have an intention to understand, to grasp, to internalize, to link different kinds of information and put them into perspective (Millis 2010). Deep learning is the intention for far most of the courses at universities, and in general one would say that the later the courses are placed in the study program the further up in Blooms and the SOLO-taxonomy the learning outcome should be.

Characteristics for deep learning. A task force from the University of Waterloo (Ellis et al. 2011) compiled the following list which includes the characteristics of students that use approaches to deep learning:

- retain knowledge and apply it in new and different contexts
- focus on relating ideas and making connections between new and prior knowledge
- come to see concepts, ideas, and/or the world differently
- engage in independent, critical, analytical thinking in a quest for personal meaning
- regulate themselves as learners
- rely on intrinsic motivation to learn
- engage in active learning by interacting with others and the course material in their learning

Many different teaching approaches that facilitate deep learning have been proposed including Meyers & Nulty (2008) principles that *engagement* of students in teaching will result in more active/deep learning.

It is my suggestion that the methods and ideas that are used in innovative processes can create teaching sessions that can fulfill most of what are characterized by deep learning as mentioned above. Innovation processes in teaching may therefore not only be relevant to fulfill the political agenda and strategy of the University, but also be a very useful teaching tool that can promote deep learning.

The teaching session

The setting. I am course responsible for Animal Parasitology (15ECTS) which is the last mandatory course before the master thesis project in the study program 'Master in Parasitology'. Students are therefore soon finalizing their master degree and their understanding is expected to be at an advanced level, i.e. the qualitative level (relational and extended abstract) in the SOLO taxonomy. This year 11 students attended the course and the present teaching exercise was placed at the end of the course. As part of the course, the students are introduced to different parasites of domestic animals and they learn different ways to diagnose and quantify these parasitic infections.

The aim. The students should learn and try to go through an innovation process and come up with new ways to diagnose parasitic infections.

The teaching. Two hours were allocated. Nine of the 11 students attending the course participated in the teaching and 5 of the 9 students were from the Nordic countries. Two groups of 4 and 5 students were formed in a way so they were as heterogeneous as possible regarding their gender, nationality, and educational background.

During the course, we have had several group exercises and ‘two and two’ discussions but as this exercise was somehow unfamiliar to the students (and to me as well!) extra time was used to set the scene and introduce the students to the exercise, and for me to get to know whether they have prior experience with this kind of exercise. We all had to move out of our comfort zone to conduct this exercise. Likewise, before each new step/exercise as described below they were carefully instructed in what to do.

Then I explained the ‘rules for brainstorming’ (see A appendix). Despite that many said that they have tried to brainstorm before, only few know and follow the rules which hamper a proper process. It is therefore important to use a couple of minutes to go through these steps.

I started with a ‘warm up exercise’. Individually, they were given 3 minutes to come up with as many bad ideas as possible in whatever field. E.g. ‘selling sand in Sahara’, ‘free speed limit for cars in towns’, ‘selling parasites to the farmer’. After that they were allowed 5 minutes to share their bad ideas in the group. Then they should agree on one bad idea (e.g. by using ‘dot voting’) and move on with that one. They were then given 3 minutes individually to come up with as many good reasons how this bad idea actually could be turned into a good idea, and was then given 5 minutes to share their ideas. Then each group was given 5 minutes to share their bad idea with the other group and how and why this bad idea actually was a good idea.

The exercise (more in line with the course). The students were given 5 minutes to brainstorm on ideas and ways to make new diagnostic tools within animal parasitology. On their own, each student should come up with as many ideas as possible and then select one which he or she would continue to work with. This idea was put on an A3 paper and they were then given 1 minute to present the idea to the rest of the class. Then they had ‘brainwalking’ where they circulated in the class having 1 minute at each of the other fellow student's ideas. They should add as many ideas (using 'post-it' labels) to their fellow student's project as possible during that 1 minute and then move to the next. After that, each project idea holder had time to look at all the inputs – to organize them and consider if they could use some of them. Then they should develop a diagnostic test, i.e. how it should work and best if they could support this process by drawings, figures etc. on the A3 paper. At the end, each student presented his or her project idea to the rest of the class.

I had some oral feedback in the class and the students were asked to fill out a questionnaire (see B appendix).

Observations, Feedback and Reflections

General. Only one had not tried to work with brainstorming and idea generating processes before and 7 had used it during their education (high school and/or university).

When it comes to activating the students I think it is rare to see the students so engaged and activated as during this exercise. Each student had time on his/her own to think and work independently but was also active in the other fellow students 'projects' by contributing with ideas and knowledge. There was lots of positive interaction among the students. Things were going on in a positive and open atmosphere.

The opening exercise turned out to be very important for several reasons. First, even though some of them had tried to work with brainstorming before, the 'non-judger' idea during brainstorm was new to many and helped them to speak out. Secondly, several of them mentioned that it was interesting that even bad ideas could be turned into good ideas, which encouraged the students to actively participate. Thirdly, it created a relaxing atmosphere due to the funny and crazy ideas and lastly they tried the process from 'ideas to product'.

Written responses from the students

Activation of knowledge. All responded that the exercise had activated their knowledge, but from the responses I can see that they have not been aware of how much of their knowledge they actually used during the exercise. If you do not know the lifecycles of parasites and which kind of molecules/parasite stages you might be able to target/measure then this exercise would be impossible to conduct. It will therefore be good to clarify this aspect to the students next time, both for them to be aware of, and as it is motivating to acknowledge what you have learned. This could be done by giving examples from their work/products on how they have activated their knowledge.

One student responded: 'it activated because you were not afraid of suggesting all of your ideas', which may be one of the good things with such an exercise, as it is crucial for the learning process to dare speak out (activate existing knowledge). Another student responded: 'I had to use my mind thinking intensively on a specific problem – that´s the best way to learn how to solve it yourself' supporting that such kind of exercise activates knowledge and promotes deep learning.

Learning outcome. The primary learning outcome the students reported was to be open minded and not critical to others ideas, e.g. 'It forced you to think out of the box and being positive (often people are only giving negative critics)'. So one can say that this is a very important lesson to learn, not only at the university, but in life in general. Interestingly, no one mentioned anything about diagnosing parasites... (which was the second learning outcome), so at least from the written feedback the major learning has been from the 'warm up exercise', maybe because the outcome was more surprising and the exercise more fun to conduct.

However, from the oral feedback several of the students also mentioned that it was interesting that they within this short time frame were able to develop new ideas and possible new diagnostic tools. I also see this as an important outcome as the students get an idea of that they can contribute and generate new knowledge which is stimulating for learning and motivates the students to learn more.

Teaching method. All but one responded that they find the exercise relevant as a teaching method, but mostly as a 'generic tool' and not specific to the course. This is maybe one of the main problems and issues when it comes to innovation; it is not part of the intended learning outcomes. Their responses may however also reflect that I have not been clear enough on the expected learning outcome of the teaching and how this exercise supports that. I should have made it clearer to the students how the different activities actually support the intended learning outcomes.

In addition, in a 15 ECTS course I think that there should be room to learn this kind of generic scientific skills (supplementary skills) as their competences as scientists are their knowledge, but also the ability to put this knowledge into action by producing new ideas and products. One could argue that it then should be put as a learning outcome for the course, but I do not think it is needed just as the ability to work in groups not are included either as it is not the main focus of the course. In addition, if it was, it would be hard to assess…

But whether this exercise facilitates the learning process when it comes specifically to diagnostic tools is harder for me to assess and may have been a too ambitious a goal to set…, but see my reflections below.

Other reflections

As this kind of teaching was new to the students I found it important to clearly explain what it all was about, i.e. the aim and outcome of the teaching, form and content and explicit told them that they might be brought out of their comfort zone.

I should have ended up by summarizing the learning outcomes. I could have showed them that they had not only generated a lot of ideas and new ways to produce diagnostic tools but also (maybe in each case) underlined how they have activated their knowledge.

One student suggested having this exercise earlier in the course which sounds like a good idea. Both to promote this way of thinking and to facilitate discussions in the class as most of the students responded that it helped them to speak out and not to be critical about others people's ideas.

Some of my 'general aims' for the students at this course are that they learn to work in a scientific and independent way, and that they learn to reflect on their knowledge and come up with solutions to specific problems – both on their own and in collaboration with others. This exercise supported that

Conclusions

Even though I cannot conclude that the used innovation processes enhanced deep learning it holds the potential to do so, as it includes all the characteristics associated with deep learning as mentioned in the beginning of this document and here supported by quoting the students responses for each point:

- ‘bad ideas can become good ones’ (retain knowledge and apply it in new and different contexts)
- ‘. . . , more like widening the thought processes’ (focus on relating ideas and making connections between new and prior knowledge)
- ‘you get another view on stuff’ (come to see concepts, ideas, and/or the world differently)
- ‘teaches you how to be analytical on your own but also with others’ (engage in independent, critical, analytical thinking in a quest for personal meaning)
- ‘Yes, in the way that one gets an indication on what to investigate further. . . ’ (regulate themselves as learners)
- ‘. . . relevant for the professional life’ (rely on intrinsic motivation to learn)
- ‘it activated [knowledge] because you were not afraid of suggesting all of your ideas’ (engage in active learning by interacting with others and the course material in their learning)

And finally this response from a student:

‘An exercise like this opens your mind and helps to investigate new ideas, which are crucial in a teaching/learning process’.

Innovation processes may therefore facilitate deep learning but it is very important to find suitable problems and areas to work with which may be a difficult task. But if possible, innovation processes holds the potential to both produce students that are more innovative and are deep learners.

A

Brainstorming rules:

- Defer Judgement – Don’t judge your own ideas or those of others
- Go for volume – 100 better than 10
- One conversation at a time – focus
- Encourage wild ideas – the crazier the better
- Build on the ideas of others – leverage perspectives
- Stay on topic – stick to the “how” problem
- Be visual – communicate your ideas for teammates by sketching (Source: D.school, Stanford University) (taken from http://innovationenglish.blogs.ku.dk/metode/classic-brainstorm)

B

Student feedback on ‘Innovation process - bring knowledge in action and ideas to life’

Have you tried to work with brainstorm and idea generating processes before (yes/no)?
If yes – in what settings/where?

Do you think the exercise was relevant as teaching method (yes/no)?
If yes – why?

Do you think the exercise activated your knowledge (yes/no)?
If yes – in which way?

What was your learning outcome/what did you learn from the teaching?

13

Determining the Effect of TLAs on Student Engagement, Activity, and Understanding in a Repeated Teaching Setting

Toine Bogers

Det Informationsvidenskabelige Akademi, Faculty of Humanities, University of Copenhagen

Introduction

Search engines such as Google, Yahoo! and Bing, have evolved into complicated systems with many interrelated components. However, the basics behind their inner workings are relatively straightforward. The challenge in teaching students how search engines work is to break down the perceived complexity of search engines and make the students see through the complicated mathematical models down to the main conceptual steps.

How search engines work is one of the topics in the course *Digitale vidensssystemer* (DV) that I have co-taught at *Det Informationsvidenskabelige Akademi* (IVA) for the past three years. DV is organized around three different topics that are all semi-related: (1) indexing and categorization, (2) bibliometrics, and (3) search engines. I am responsible for three lectures on search engines and it is the final lecture in this series that serves as the context for my final adjunktpægagogikum project. The topic of the final DV lecture is specialized search engines, such as recommender systems, question-answering systems, and expert search engines. Teaching this specific topic of expert search is what I wish to focus on in my adjunktpægagogikum project. Expert search engines are search engines that allow users to search for people that are knowledgeable about a particular topic (as opposed to, e.g., Google, which allows you to search for Web pages).

More specifically, I want to investigate the value of different teaching/learning activities (TLAs) for teaching my students about expert search engines, and find out which TLA is most effective in terms of engaging the students, increasing their activity level in-class, as well as their understanding of the topic (in terms of reflection). This leads to my problem statement (PS) for this project:

PS What is the effect of different TLAs on student learning of the workings of an expert search engine?

Student learning as such is a broad concept and in this report I will attempt to address it using three research questions (RQs). One aspect of student learning that I wish to address is the concept of *student engagement*:

RQ 1 What is the effect of different TLAs on student engagement?

Engagement does not have a single, static definition, but as an appropriate working definition for this project report, I will use Chapman (2003), who defines it as the students' cognitive investment in, active participation in, and emotional commitment to their learning (Chapman 2003).

In-class activity levels are a specific part of Chapman's definition of engagement. However, because *student activity* is so often seen as being conducive to student learning as well as being one of the most directly observable outcomes for a teacher, I wish to focus on it specifically in my second research question:

RQ 2 What is the effect of different TLAs on student activity levels?

When answering this question, I want to focus on not just the teacher's perception of activity, but also on the student's perception of their own activity level as well as that of their fellow students to get a more complete picture of the effect of the TLA.

Finally, the goal of any TLA is to make students obtain knowledge and understanding of the topic(s) being taught. For this reason, the last aspect is wish to focus on through one of the research questions is *student understanding*:

RQ 3 What is the effect of different TLAs on understanding (in the form of reflection)?

I will attempt to answer these research questions by taking advantage of the structure of DV, which is divided into five different groups of 25-

30 students. DV has *sequential co-teaching*, which means that a different teacher comes in to cover each of the three topics. These five groups are taught by these three teachers in succession: teacher 1 has all five groups the first four weeks, teacher 2 the second three weeks, and I have all five groups at the end for three more weeks. This means that *within* each teacher's respective teaching period, repeat teaching takes place where each week the lecture content is repeated four times so that all five groups are exposed to the same lecture content. However, this also allows for different groups to be exposed to different TLAs, as long as the lecture content stays the same. I want to take advantage of this setting to gauge the effect of different TLAs on student engagement, activity, and understanding.

The remainder of this project report is organized as follows. The next section presents a brief overview of work related to the topics of engagement, activity and understanding and how different TLAs affect these. The section afterward presents the methodology of the aforementioned semi-controlled experiment with TLAs in more detail. That section is followed by a presentation of the results of this experiment with regard to my research questions. I conclude by discussing my findings and their implications for my future teaching.

Related work

Measuring the effect of different types of TLAs on students is not entirely new. For example, Andersen (2010) performed a similar controlled experiment when he compared a more traditional combination of lecturing and exercise classes with student-centered teaching, where brief lecture segments were intertwined with brief exercise segments (Andersen 2010). However, his experimental structure was a within-group design where the same students were exposed to two different types of lectures and quizzed at the end. This allowed him to compare the effect of these lecture types with the same group of students and directly measure their progress. My study is different in that it focuses on a specific TLA element in a larger lecture and that it takes place in a between-group design where I can concurrently measure the effect of different TLAs, ruling out any possible learning effects, as opposed to the more common sequential nature of Andersen's study.

Measuring student engagement with courses and individual lectures is not the easiest of endeavors, despite being deemed extremely important by many for effective student learning. One reason for this is that our understanding of what it means for a student to be engaged in teaching and learning has evolved over time (Chapman 2003, Nystrand & Gamoran 1991, K. A. Smith & Johnson 2005, Zepke & Leach 2010, Biggs & Tang 2011). Chapman (2003) presents a clear and concise overview of the evolution of engagement (Chapman 2003). In this report, I elected to stick to her own working definition of engagement as the students' cognitive investment in, active participation in and emotional commitment to their learning. Zepke & Leach (2010) offer a list of ten proposals for increasing student engagement. Two of these proposals were selected in particular for this report, because of their practical nature and manageable scope: (1) "enhancing students' self-belief", and (2) "enabling students to work autonomously, enjoy learning relationships with others and feel they are competent to achieve their own objectives" (Zepke & Leach 2010, p. 169). The two treatment TLAs that are described in more detail in follwing section aim to incorporate these proposals.

Methodology

The unique structure of DV allowed me to attempt to answer my research questions using a controlled experiment. While the lecture content of the final lecture always stayed the same, I could expose the five groups of students to three different types of TLAs when covering the topic of expert search. I measured student engagement and activity levels through direct observation as well as a survey administered at the end of the lecture. Understanding of the material was tested by including a reflection question in the survey.

The following sections describes the experimental setup in more detail, as well as the survey development and deployment. The sections after offer some more background information on the students taking DV and on the lecture in question.

Experimental setup

With the repeat-teaching structure of DV, the five groups of students could cover the same lecture content, but be exposed to different TLAs in a between-group design. I compared the effect of three different TLAs (or treatments), each corresponding to familiar paradigms from the pedagogical literature:

- **Traditional lecturing** In the traditional lecturing format I explained to the students how an expert search engine works, supported by slides and Q&A along the way. This corresponds to a *transmission-based learning* approach (Biggs & Tang 2011). Student group 1 was be exposed to this condition and served as my control group. To make sure their lecture lasted as long as for the other four groups, they were exposed to a longer group exercise on question-answering systems (QA), one of the other topics of the last lecture, to compensate for the missing expert search exercise.

- **Guided exercise** In the guided exercise the workings of an expert search engine were broken up into four different steps. For some example expertise areas, students were asked to go through each of the steps to produce a ranking of experts, which was then compared to the correct ranking. This way the students (hopefully) learned that a complex system can be broken down into simpler components and steps. This corresponds to a *problem-based learning* approach (Zepke & Leach 2010, Biggs & Tang 2011). Student groups 2 and 4 were exposed to this condition and served as treatment 1 The guided exercises was the default situation for all student groups in previous years.

- **Open discussion** In this format, I asked the students themselves to use their knowledge of how a search engine works—which was discussed in the two previous weeks—to conceptually design how an expert search engine could work and what steps would be involved in this. This corresponds to a *cooperative learning* approach (Zepke & Leach 2010, Biggs & Tang 2011). Student groups 3 and 5 were exposed to this condition and served as treatment 2.

All students received some introduction to what expert search is and why it is useful. The guided exercise and group discussion then took place in the treatment groups *before* the students were told how an expert search engine works. All students then received the same lecture segment on the two most important models of expert search *after* the exercises concluded.

Unfortunately, due to poor planning of overlapping deadlines of the different 3rd-semester courses, attendance was low near the end of the week due to an imminent term paper deadline in another course. While several students took part in one of the earlier lectures, the final two lectures had to be cancelled due to low attendance. This meant that for each of the three

TLAs I only had one student group instead of the planned two groups for treatments 1 and 2.

Evaluation

To measure the effect the three different TLAs had on student engagement, activity, and understanding, I used a combination of direct observation and a survey administered at the end of the lecture. While other methods would have also been useful to uncover the effect of the different TLAs, such as interviews or focus groups, I chose a combination of a survey and direct observation, because of the time pressure both the students as well as the teacher were under at the end of the semester.

Direct observation

While engagement and understanding are harder to evaluate through direct observation, it is possible to gauge student activity in-class in this manner. Student activity was observed by the teacher during all lectures as well as by a colleague during the group discussion lecture.

Survey

The goal of the (anonymous) survey was to measure student engagement, activity, and understanding, and as such consisted of three parts, each one corresponding to one of these aspects. For the engagement and activity parts, I asked both general questions and questions specific to the particular treatment variant (guided exercise or group discussion). All questions were in the form of statement the students were asked to (dis)agree with using a five-point Likert-scale. In addition to the TLA-specific questions, I also included questions in the engagement part about all the TLA types employed during the lecture to ensure that I would be able to compare all types of TLAs and not just the two treatment TLAs.

The students in group 1, who were exposed to the traditional-lecturing approach, received the same questions as the other four groups, even though they were not exposed to the special exercises on expert search. Instead, the four topic-specific questions were replaced with questions focusing on QA instead of expert search.

Because of the likely difficulties in stating whether a particular TLA contributed to a student's own understanding of the lecture content, I asked no comprehension or understanding questions specific to a TLA, just general question. I tested their understanding by including a reflection question at the end of the survey. I then graded the students' answers on their quality on a three-point scale: good, medium, and bad.

The survey was deployed at the end of the lecture. The survey was only made available in English to avoid nonnative translation errors skewing the results (although English comprehension could of course have gotten in the way of understanding. The survey was made available to the students in both a paper and an electronic version. Students were free to pick their version of choice, but all students were asked to complete the survey before leaving the lecture. Appendix A contains the paper version of the survey.

Student characteristics

All of the ca. 150 third-year students have to take DV and at the start of the semester they were therefore divided up into five classes of around 30 students each. The majority of the students were in their second year of studying at IVA. The type of students that choose to study Library & Information Science (LIS) typically do not have a high aptitude for mathematics. While this in and of itself is not a problem, it is relevant when teaching a subject like search engines. The algorithms that make up a search engine are typically described using mathematical formulas, such as the calculate of term weights that tell the computer which terms are most important for a document. Experience has taught me that I need explain these formulas carefully and step-by-step (if it is necessary at all). I also try to reassure the students that are intimidated by the (arguably little and simple) math in the required reading that, while I will explain the math in as simple terms as possible, it is the principles behind these algorithms that are most important.

The teaching language for me (and for one of the other DV teachers) was English, although students were encouraged to ask questions in whatever language they were most comfortable with, Danish or English. This also applied to their term paper, which was the exam form of the course.

Lecture description

The topic of the final DV lecture was specialized search engines, which are search engines designed to perform a specific task or design to operate in a specific domain. In this lecture I covered three examples of specialized search engine technology in the following order:

- *Expert search engines* (ES) are search engines that allow the user to search for people instead of documents. An expert search engine tries to automatically associated evidence of expertise (publications, social connections, project activity, etc) with experts and then rank them in order of perceived expertise. It was this topic that was the focus of my experiment with different TLAs.

- *Question-answering systems* (QA) are systems that directly attempt to answer questions asked by the user, such as “What is the capital of Paris?”. Instead of the user having to transform such a question into a set of keywords, entering those into a search engine, going through the results list, and extracting the right answer(s) from these results, a QA system tries to automate these steps.

- *Recommender systems* (RS) are systems that attempt to recommend interesting items for future consumption based on past user preferences and/or purchases. A good example of a website that employes recommender systems is Amazon.com, which attempts to recommend other items to buy based on past purchases and purchases by others (e.g., “Customers who bought this, also bought ...”).

13.1 Results

Figure 13.1 shows the answer distribution for all eleven questions relating to engagement, activity, and understanding over all 32 students combined that made up the three student groups. Bars in Figure 13.1 (and the other two figures) are color-coded by survey responses: green-colored bars represent (strong) agreement, while red-colored bars represent the (strong) disagreement. Deeper greens/reds represent stronger (dis)agreement. Median scores for each questions is represented by the 50% mark on the horizontal axis. In general, all students reacted very positively to the lecture: for five statements the median score was 5 and for the remaining six statements the median was 4.

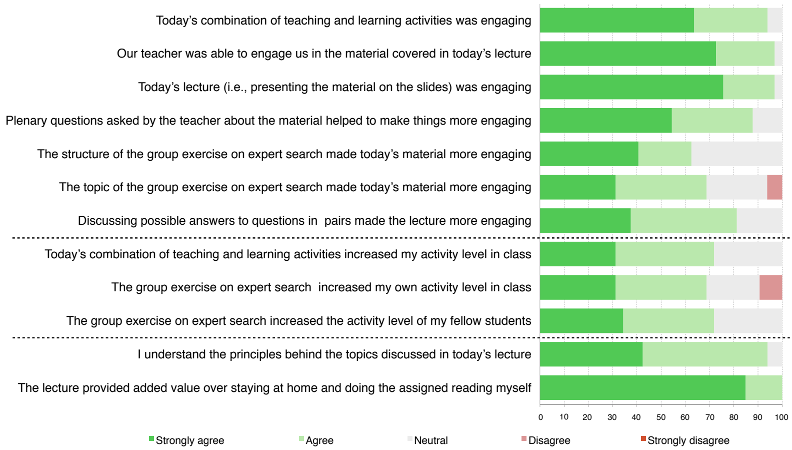


Fig. 13.1. Overview of the answer distribution for the twelve survey questions (N = 32)

Engagement

Overall, a majority of students stated that they felt (strongly) engaged by all types of TLAs. It is interesting to note, however, that the students actually were most positive about traditional lecturing as a TLA with around 75% of all students strongly agreeing with being engaged by this TLA. In contrast, the TLAs where students had to become more active by answering questions or discussing them with one or more of the fellow students scored slightly lower, although median scores were still all 4 or higher.

For the expert search-specific questions, I was interested in gauging their response to both the structure and the topic of the exercise to be able to separate the influence of these two factors on their feeling of engagement for the two treatment TLAs: the group-discussion variant vs. the guided-exercise variant. Figure 13.2 shows the answer distributions split by treatment type[1]: the group-discussion variant on the left vs. the guided-exercise

[1] It was not possible to compare the these two treatments to the control condition (traditional lecturing), because the lecturing-specific question was asked about the entire lecture and not just the expert search part. This means this was not directly comparable, weakening the setup of the controlled experiment. This should be addressed in future work).

variant on the right. From the distribution in Figure 13.2 it appears that students felt that the guided exercise engaged them more than the group exercise engaged the other group of students. The difference in median scores reflects this, with median scores of 4 for the guided exercise vs. median scores of 3 for the group discussion. However, when comparing the expert search-specific statements on engagement using a Chisquare test, it revealed no statistically significant relationship between treatment type and engagement as a result of the structure of the group exercise ($X^2(2, N = 22) = 2.011$, $p = 0.366$). Likewise, there was no statistically significant relationship between the type of treatment TLA and engagement as a result of the *topic* of the group exercise ($X^2(3, N = 22) = 2.377$, $p = 0.498$). Other comparisons between these two student groups or all three groups also revealed no statistically significant relationships between the groups.

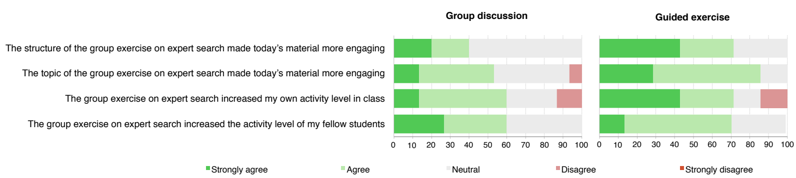


Fig. 13.2. Overview of the answer distribution for the four questions related to the non-lecture conditions ‘group discussion’ ($N = 15$) and ‘guided exercise’ ($N = 8$).

Activity

From the distribution visualized in Figure 13.1, it appears that students felt they were less active in class than they were engaged, which suggests that separating these two concepts was a good decision. However, when spliting their answers up by treatment TLA in Figure 13.2, there are some small differences in how students perceived their own activity vs. the activity of their fellow students. Students felt that while the guided exercise activated themselves more, the group discussion exercise seemed to activate their fellow students more. However, these differences are not statistically significant ($X^2(3, N = 22) = 2.538$, $p = 0.469$). Likewise, there was no statistically significant relationship between treatment type and activity of other students as a result of the group exercise ($X^2(2, N = 22) = 1.155$, $p = 0.561$). Interestingly, both my observations and those of the external observer suggested that the group discussion exercise was actually the most successful TLA for activating the students. This suggests a possible disconnect in how teachers and students define 'activity' in class.

Comprehension

The bottom part of Figure 13.2 shows that students from all groups seemed very confident in having understood the principles behind the topics of the last lecture with a median score of 5. In addition, 84% of them strongly agreed with the statement that the lecture provided added value over staying home and doing the assigned reading for themselves.

When testing their actual understanding of expert search through a reflection question on how to incorporate the temporal dimension into an expert search engine, the results were not as overwhelmingly positive. Of the 32 students that answered the questions, only 31.3% submitted a good answer, while 50.0% submitted a medium-quality answer and 18.8% of the students would have failed, were this a real exam.

Figure 13.3 shows the answer distribution split by the three TLA types. Considering this split, it is perhaps surprising that, considering their feelings about their own engagement and activity, the group discussion students entered the highest number of good answers at 40%. And while the guided exercise-group judged their engagement and activity as the highest among all groups, they had the lowest number of good answers of all three groups. However, according to a Chi-square test there was no statistically significant relationship between the TLA type and the answer quality $X^2(4, N = 32) = 2.055$, $p = 0.726$).

Discussion & Conclusions

In this project report I have presented a small-scale pilot study on the effect of different types of TLAs—traditional lecturing, a guided exercise, and group discussion—on student engagement, activity, and understanding in a repeated teaching setting. When it comes to *student engagement*, students seemed to be feel more engaged by the guided exercise, where they were taken through a series of steps that signified how an expert search engine worked, than discussing how expert search engines worked in a group.

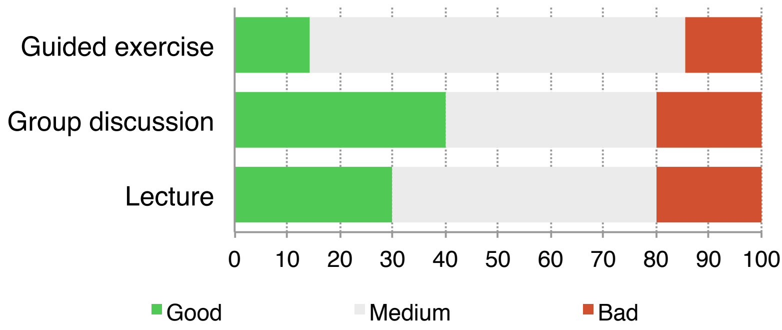


Fig. 13.3. Overview of the grade distribution for the three different conditions (N = 32).

However, overall students reported feeling engaged the most when being exposed to the traditional lecturing format. A possible explanation for this could be that students are simply more used to the traditional lecturing format and that discussing in groups makes some of them more uncomfortable and therefore less engaged. Another problem could be that students interpret the concept of engagement differently. While I purposefully did not define it beforehand, it does make it harder to compare the results.

Looking at the survey results, the effect of the type of TLA on *student activity* levels was not as marked as it was for engagement. An interesting finding in terms of activity was that while students felt that the guided exercise activated themselves more, the group discussion exercise seemed to activate their fellow students more. A possible explanation for this could be that with the guided exercise every single student has to contribute, as the students typically divided the different assigned expert areas amongst themselves. This meant that students were very aware of suddenly having to become active themselves, while the activity of other students became less visible to them. In contrast, group discussion makes it easier for a student to 'hide' in the group, while it makes the activity of their fellow students much more visible. From a teacher's perspective, however, direct observation suggested that the group discussion exercise resulted in the highest activity levels.

Evaluating the student's *understanding* of the material covered in the lecture showed a different picture than that of engagement and activity. In addition to the group discussion format producing the most activity, students participating in this format also produced the best answers to that exercise, as they came up with exactly the answers I was hoping for as well as some original solutions I had not considered myself. This was also reflected in the answers to the comprehension question in the survey.

The results presented in this report should be taken as those of a pilot study: the number of students participating in this last lecture was too low to be able to draw statistically meaningful and representative conclusions. In addition, direct observation and surveys might not be the best methods to get at the students' attitudes towards engagement. Interviews or focus groups would make a good complement in future work in this area.

On a personal level, I plan to use the group discussion variant more extensively in the future, because of my positive experiences with the student's activity level and the quality of their answers during and after this type of TLA. However, this does not mean the other two TLAs are without merit. For instance, the guided exercise could easily be re-worked into an online quiz that would allow the students to test their understanding of the documentcentric expert finding model at their own pace, providing an additional check on their understanding of the material.

A Survey questions

Survey on teaching & learning activities in Digitale Videnssystemer

The goal of this survey is determine your attitudes towards specific different teaching and learning activities in today's teaching and how you experienced the lectures as a whole. Thank you in advance for participating!

Please rate the following statements on how you've experienced today's lecture for how much you agree or disagree with them.

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Engagement	Today's combination of teaching and learning activities was engaging	○	○	○	○	○
	Our teacher was able to engage us in the material covered in today's lecture	○	○	○	○	○
	Today's lecture (i.e., presenting the material on the slides) was engaging	○	○	○	○	○
	Plenary questions asked by the teacher about the material helped to make things more engaging	○	○	○	○	○
	The **structure** of the group exercise on **expert search** made today's material more engaging	○	○	○	○	○
	The **topic** of the group exercise on **expert search** made today's material more engaging	○	○	○	○	○
	Discussing possible answers to questions in pairs made the lecture more engaging	○	○	○	○	○
Activity level	Today's combination of teaching and learning activities increased my activity level in class	○	○	○	○	○
	The group exercise on **expert search** increased my own activity level in class	○	○	○	○	○
	The group exercise on **expert search** increased the activity level of my fellow students	○	○	○	○	○

(Please turn the page)

Comprehension	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I understand the principles behind the topics discussed in today's lecture	O	O	O	O	O
The lecture provided added value over staying at home and doing the assigned reading myself	O	O	O	O	O

Finally, I would like to ask a question to test your understanding of one of today's lecture topics. This is of course not a part of your final grade. Nevertheless, please answer this question to the best of your ability and write your answer (either in Danish or English) in the box below.

Question:
Expertise on a particular topic X is very dependent on time: although a particular researcher might have been an expert on X twenty years ago, if (s)he has not done any research on X since then, her/his expertise is probably not that high anymore. Conceptually, how could we add this time dimension to an expert search engine to make it more realistic? Is there a particular stage or phase we could add this information?

Thank you for your participation!

14

Student-activation during lectures as a *Process* to elucidate the *Presage* of students and facilitate the learning *Product*

Henrik Hjarvard De Fine Licht

Department of Plant and Environmental Sciences, University of Copenhagen

Introduction

One-way flow of information from teacher to students encompassed in the traditional lecture format may not always promote optimal student learning. Exercises that activate students are a way to break the lecturing monotony and may also enhance student learning by presenting the subject in a different form and by stimulating deep learning and self-reflection (Prince 2004, Dahl & Troelsen 2013). Deep learning depends on establishing concepts or understanding ideas while making links to what is already known as opposed to rote learning, where information is forcibly stored in the long term memory by repetition (Entwhistle 2009).

The 3P-model is a conceptual framework to analyze how teaching can support and promote deep student learning (Mørck & Rump 2013), and focuses on teaching activities and what the students should do to promote deep learning approaches (Prosser & Trigwell 1999). The 3 P's stand for *presage* (characteristics and previous experiences of the students and teacher), *process* (students approaches to learning and teachers approaches to teaching), and *product* (the learned outcome of teaching for the student) (Prosser & Trigwell 2006). Because a clear link between the student's perceptions of their learning environment and their approach to learning has been established (Trigwell et al. 1999, and references therein), a fourth P, *perception*, is sometimes included.

According to the 3P-model, learning can be viewed as a conceptual change in the relation between a student and his/hers view of the world (i.e. by providing nuances and expanding the previous view of the world)

(Prosser & Trigwell 1999). The initial worldview is very much dependent on the already learned skills of the student, and when teaching it is often useful for the teacher to know the starting level of the students at the onset of teaching to adjust the teaching accordingly (Biggs 2003). The students may also benefit from directly assessing their starting knowledge prior to teaching specific subjects, because assessing their initial knowledge of a subject make it evident what new knowledge they have gained. Exercises during lectures that assess the starting knowledge of students then serve a dual purpose of (1) breaking up the monotony of the lecture format, and (2) helping the students to clearly identify what they have learned during the lecture - the learning *product*. This project explored whether such student-activating exercises make it easier for students to identify what novel information they have acquired and how the new knowledge adds to their previously acquired knowledge.

Method

Approach

The experimental approach consisted of two types (A and B) of activities that were tested during two lectures.

A. A multiple-choice type of question to rate their overall knowledge of the subject on a five-point scale (Figure 14.1), for example: "how much do you know about frogs?" This question assessed the students' own perception of their preliminary knowledge of the subject that was about to be taught in the lecture. The students were asked to answer the same question with the same possible answers again at the end of the lecture. The idea being that by directly showing how the students' own assessment of their gained knowledge (presumably) increased during the lecture would help them identify the learning *product*.
B. Prior to covering specific subjects within lectures, the students were asked subject specific questions either in the form of interactive multiple-choice questions (using the software *Shakespeak*) or specific questions that were first discussed in pairs before a teacher-led discussion among all students concluded and provided the correct answers (See appendix A). The idea here being that the students were asked to reflect (*process*) on the specific subject using their preliminary knowledge (*presage*), in order to better identify their learning *product*.

Finally, after each lecture the students were asked to (1) evaluate their learning outcome of the lecture, (2) if the small exercises benefitted their learning outcome, (3) if the small exercises helped them identify what new knowledge they had gained, and (4) if their overall view on the subject had changed (See appendix B).

Course description

Student-activation exercises were tested during lectures given in the course *Diversity of Animals and Plants* for first-year BSc. students studying *Natural Resources*. The course has a workload of 7.5 ECTS and is evaluated by a four-hour written mainly closed-book examination. The course provides an overview of plant and animal diversity with an emphasis on the classification and identification of the Danish flora and fauna. Like many other subjects this is a large subject to cover in a 7.5 ECTS course, and the main objectives of the course is to provide the students with a framework to classify plants and animals. The exercises in this course focus on species identification of plants and animals and the students learn how to use identification-keys. The course thus consists of elements that are low in the SOLO taxonomy of learning (Biggs 2003), i.e. list, define or describe, in addition to more relationel elements such as an understanding of animal and plant classification that are medium on the SOLO taxonomy (i.e. explain or use).

Implementation

In teaching block four, Spring 2014, the course *Diversity of Animals and Plants* had 75 registered students. During two lectures student activiation activities of type A and B described above where implemented. The topics of the two lectures were *Fish* and *Amphibians and Reptiles*, respectively. For both 90-minute lectures, this was all the information on these two subjects that were presented during the course. It is the first time the students' encounter these topics in the *Natural Resource* first-year curriculum, but I argue that everybody know something about e.g. fish and frogs making these topics ideally suited to link prior knowledge (*presage*) with the taught material using student-activation exercises during the lectures (*process*) to increase the learning *product*.

In the first lecture on *Fish* the first slide presented the students with a multiple-choice question asking them to rate their knowledge on fish, which were repeated at the end of the lecture (question type A). In addition a question type B were included in the middle of the lecture to have student activation exercises spread out more evenly during the lecture.

For the second lecture on *Amphibians and Reptiles* the question type A were omitted based on the experience from the first lecture, and only type B questions were included during the lecture.

Results and Discussion

This project explored whether student-activating exercises that assess students' preliminary knowledge prior to being taught the subject make it easier for students to identify what novel information they have acquired and how the new knowledge adds to their previously acquired knowledge. This is encapsulated in the 3P-model of student learning (Prosser & Trigwell 1999, 2006), which provided the theoretical framework to explore possible correlations between students' awareness of their preliminary knowledge and the learning outcome.

Question		Start	End
A	I'm an Ichtyologist!	1	3
B	I know a lot oabout fish, for example how their skeleton and muscles are build	0	19
C	I know some about fish, and sometimes i go fishing, diving, or I keep fish tanks	7	3
D	Fish tastes nice and lives in water	17	2
E	Fish, what is that?	1	1

Fig. 14.1. Number of student votes at the beginning and end of lecture 1 on the five questions meant to assess student preliminary knowledge.

Specific activation exercises that asked the students to assess their preliminary knowledge were implemented in two lectures attended by 41 and 56 students, respectively, in the course *Diversity of Animals and Plants*. There was no significant difference $(\chi 2 = 0.01, df = 1, p = 0.914)$ between the two lectures in number of students that answered that their learning outcome were in complete accordance (54% and 58%, respectively) and somewhat in accordance (37% and 42%, respectively) with the content of the lectures. This shows that similar proportions of students had the same experience of "understanding" the taught subjects in the two lectures.

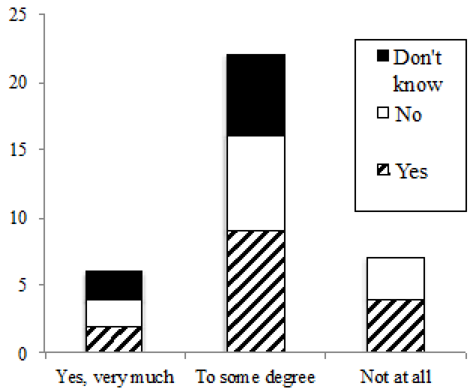


Fig. 14.2. Number of student answers to the question: “Did it help your learning outcome to assess your preliminary knowledge at the beginning and again at the end of the lecture?” in lecture 1 (N = 35; 85%). Crossed, black and white markings denote answers to the question: “Have your view on fish changed because of this lecture?”

In the first lecture the students’ initial knowledge about the topic (fish) was assessed at an unspecific meta-level by asking the students how they would rate their knowledge on the subject (Figure 14.1). The students enjoyed this exercise and it spurred interest and created a good atmosphere in the room. Revisiting this question at the end of the lecture also gave the maybe obvious result, that the students’ perceived themselves to have learned something during the lecture (Figure 14.1). However, the evaluation of the lecture revealed that most students felt that assessing their preliminary knowledge did only improve their learning out come to some degree (Figure 14.2). In the second lecture the question at the onset of the lecture meant to promote self-reflection was therefore omitted, and instead questions were used just prior to covering specific subjects. The didactic phases of these questions were similar: devolution (teacher presents a question framing the ’didactic environment’), action (students think on their own), formulation (students discuss among themselves), validation (students present solutions during teacher-led discussion), institutionalization (teacher presents official knowledge and relate to the general themes of the subject) (Christiansen & Olsen 2006). The approach used here is a common way to activate students during large classes by having them discuss with their neighbour for a few minutes before discussing the answers with the entire lecture hall.

Having the exercises prior to covering the specific subjects in the lecture served the additional purpose of making the students aware of their preliminary knowledge when trying to solve the assignments. From the evaluation of lecture two it was clear that many students were encouraged to assess their starting knowledge (Figure 14.3). After both lectures the students were also asked whether their general view on fish and amphibians and reptiles, respectively, had changed. Interestingly, the students' perception of the two lectures differed markedly. In the first lecture where the majority only felt that the initial assessment had helped them to a certain degree (Figure 14.2), there was no significant difference between students that answered yes or no to whether the lecture had changed their view on the subject ($\chi 2 = 0.33, df = 1, p = 0.56$). In the second lecture where most students' agreed that the exercises made them think a lot or somewhat about their initial knowledge on the subject significantly more also said that their view on the subject had changed ($\chi 2 = 5.2, df = 1, p = 0.013$). The formulation used in the question: "...changed your view..." is not very precise and it is possible that students understood the meaning of the phrased question differently. However, the subject of these lectures, well-known animal groups of fish, amphibians and reptiles that most people have some form of acquaintance with make it reasonable to infer that the student answers imply a general change in their view on them.

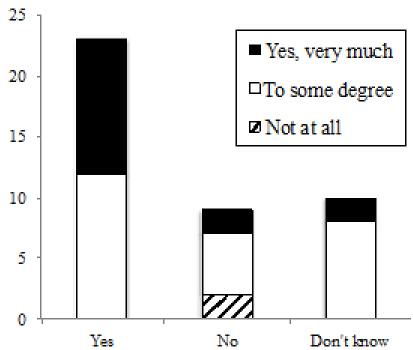


Fig. 14.3. Number of student answers to the question: "Have your view on amphibian and reptiles changed because of this lecture?" in lecture 2 (N = 43; 76%). Crossed, black and white markings denote answers to the question: "Did the two preliminary exercises make you think about how much or little you knew about the subjects beforehand?"

A change in the students' perception of the subject is at the heart of the 3P-model where the interplay between deep learning approaches and changes in the students' view of the subject is emphasized. It is therefore tempting to conclude that the results of this study, at least in lecture two, is in agreement with the 3P-model. By asking the students if their view on the subject had changed the intention was to obtain their subjective perception of the taught subject, which is one of the important parameters that change when facilitating deep learning according to the 3P-model. However, it is often stated that students' own evaluation of their learning outcome is unreliable because they lack the necessary background knowledge and overview of the subject to adequately judge their own skills (Horst et al. 2013). This creates a conundrum where on one hand the aim is to alter the students perception of the subject to facilitate deep learning but at the same time the students own perception is unreliable as a measure of how effective this approach is. One solution would be to continue with this type of initial assessment exercises during the full length of a course and then evaluate exam results, which in theory should be devoid of perceptive bias (Horst et al. 2013). Another possibility would be to have exam-like questions at the end of lectures to let the students themselves and the teacher evaluate the learning outcome. Finally, this conundrum may be trivial because the main focus is on having subject-relevant student activation exercises that the students (and the teacher) perceive as a help to make them aware of what gaps in their knowledge they had beforehand and how the taught subject helped fill these gaps. In other words, if the students have the feeling these type of exercises help them assess their previous knowledge - maybe they actually do just that.

Conclusion

The 3P-model provides a usable theoretical framework for testing questions of how to improve student learning, and student activation during lectures is a good way to diversify teaching methods and maintain the students' interests throughout lectures. Apart from the didactic purpose of presenting the subject in different forms and contexts, this project indicate that questions during lectures formulated and used appropriately is capable of inducing self-reflection over the extent of students' own initial knowledge. However, whether such student self-reflection also leads to a higher learning product and induces deep learning cannot be unambiguously concluded from this study.

A Example of subject-specific questions in amphibians

- What does frogs/toads eat?
- What does tadpoles eat?
- Does frogs/toads and tadpoles have long or short intestines?

B Example of questionnaire to evaluate lecture 2

Marker ud for det svar der bedst beskriver din oplevelse af forelæsningen.

1. Hvordan oplevede du dit udbytte af forelæsningen i forhold til forelæsningens indhold?
    - Ikke i overensstemmelse
    - Nogenlunde i overensstemmelse
    - I fuld overensstemmelse
2. Hjalp det på dit overordnede faglige udbytte at have en lille aktivitet om padders føde og tarmlængde og generelle krybdyrkarakterer inden selve gennemgangen af stoffet?
    - Overhovedet ikke - det gjorde ingen forskel
    - I nogen grad
    - I høj grad
3. Fik de to indledende aktiviteter dig til at tænke over hvor lidt/meget du vidste om emnerne på forhånd?
    - Overhovedet ikke - det var bare irriterende
    - I nogen grad
    - I høj grad
4. Har dit syn på padder og krybdyr ændret sig på baggrund af denne forelæsning?
    - Nej
    - Ja
    - Ved ikke

15

Utilizing case-work for inducing reflective thinking and interpretation skills

Pai Pedas

Department of Plant and Environmental Sciences, University of Copenhagen

Introduction

A multi-disciplinary approach in university teaching involves teachers and/or scientists with different scientific expertise as well as didactic competences. However, the multiple teacher courses can result in teachers only having the opportunity to teach one or two times during a course. The students may therefore be exposed to many different forms of teaching during a course. It can therefore be an advantage to present in every lecture the intended learning outcomes (ILO's) so the students know what is expected of them in terms of gained knowledge and/or expertise from each lecture. In general, lectures are used to present the scientific information whereas several different teaching learning activities (TLA's) is needed for obtaining deep learning enabling more reflective thinking and interpretation skills.

Generally the use of lectures in the means of student learning can be questionable. Several statements from the paper by Gibbs (1981) are illustrating the possible drawbacks of lecturing:

- Lectures is not more efficient than other methods in relation to the ability of students to learn factual material – it is even suggested that unsupervised reading is more effective in terms of learning facts.
- Students are inactive during lectures – more than 75% of the students are having passive thoughts about the subject or other irrelevant issues.
- Lectures are not motivating.

- Student notes from lectures only contain 21% of the presented material and in some studies less than 15% of students taking notes did subsequently read the notes.
- The lecturer cannot easily adjust to individual students existing knowledge and manner of learning – lectures are generally not very flexible.
- The final ILO's for individual students varies in relation their knowledge/course prerequisites.
- The lecturing pace is very critical as students are forced to understand what is being said or just attempting to record what is being said. Is it facts-based lecturing or more complex information being presented?

However, the potential drawbacks of lecturing are depended of the stated ILO's for the course or the individual lecture and how the lecture is combined with other TLA's during the whole teaching session. The objective of a given lecture can be different from the overall course objectives if the lecture is a preparation for student activation in other TLA´s resulting in achieving the course objectives (Gibbs 1981), e.g. more deep and complex understanding of the topic. However, activation of students during the lecture is very important, as studies have shown that a low activity level results in decreased learning. In a traditional lecture with the lecturer having more or less a monolog in the classroom the student activity level is low and a significant part of the teaching information is not absorbed by the students. It is estimated that an average student is able maintain focus for approximately 10-15 minutes, then the concentration drops markedly. However, maintaining the high concentration level can be achieved by introducing varying TLA's forcing the student to change and interact in the teaching session (Biggs & Tang 2011), see figure 15.1 for overall student learning outcomes in relation to activity changes.

Throughout the first one or two years at the university the students are often not exposed to any significant activation during lectures, especially in the basic courses in chemistry and mathematics with > 100 students in the auditorium. In following courses it can therefore for some students be quite challenging or even embarrassing to ask questions and interact in the teaching in front of the other students, either because the student feels scientific or personally insecure. To say something wrong or "stupid" will for some students be the same as a personal defeat and a very awkward experience. It should always be ok to ask questions no matter quality or how scientific the question is. The teacher should acknowledge the question and used it constructively. A course with many teachers will potentially also have the

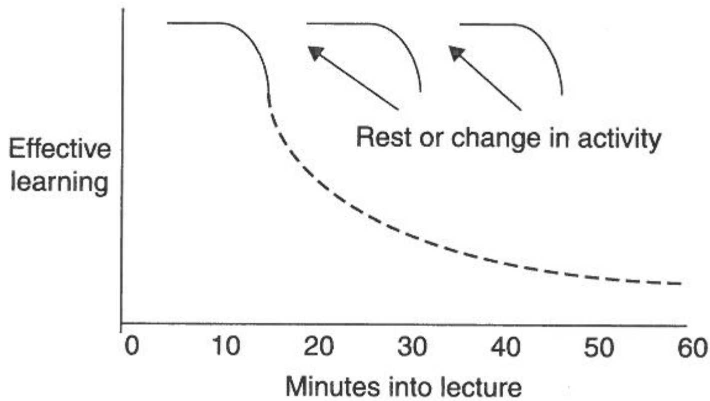


Fig. 15.1. The effect of no activity versus several activities on student learning during a lecture (Biggs & Tang 2011).

side-affect that students do not feel "safe" by the individual teacher and in such cases it is very important that the teachers do an extra effort to create a safe and open atmosphere facilitating the teacher-student interface. Furthermore, improving how students prepare before a lecture, e.g. reading the text-material at home, will also increase their scientific confidence. As a university teacher I have great passion for passing on knowledge and increase motivation for further studying outside the classroom and laboratories. It is especially rewording teaching at courses where the students are so eager to learn and so inquisitive that the teaching transforms into an explorative dialogue, resulting in a more reflective and deep learning. So the question remains how to facilitate this process in relation to varying scientific areas and student prerequisites. I find interactive and dialogic teaching very attractive and I am using this approach by facilitating students to combine and analyze presented facts-information and obtained laboratory results in exercises following the lecture or conducted experiments, respectively. In the present project I examined the use of case-work in relation to gain more reflective thinking and increased interpretation skills. The MSc course Advanced Plant Ecophysiology was used as a template as the course has been modified significantly throughout the last two years in order to increase the deep learning.

Course context

The course Advanced Plant Ecophysiology give students an understanding on how plants function in diverse environments and their physiological responses to environmental and climate change[1]. Eight teachers are involved in this course teaching on their particular favorite topic in according to the course description and ILO's. I have been involved in this course during the last five years presenting various topics within my expertise. However, during the last two years the course has been modified quite a bit. Previously the course was named Plant Ecophysiology and was a joint BSc and MSc course. The previous student evaluations were mixed especially in relation to teaching material, and the organization and structure of the course. In addition, the course attracted per tradition students from very different backgrounds (biology, geography, biotechnology, agronomy) resulting in students having very diverse course prerequisites. This resulted necessarily in lectures and teaching sessions presenting basic knowledge before actually handling the intended individual ILO's for the course. A new course responsible gave the opportunity to change and modify the course. A new text book was chosen and the overall course structure was aligned with the textbook used. The first year with the new text book and a new portfolio of teachers involved having other ideas regarding didactic approaches resulted in very positive student evaluations. However, in the first year with the changes the majority of the teaching was focused on presenting the fundamental scientific facts, ensuring the students were able to explain and describe the fundamental facts described in the ILO's in the course description, unconsciously resulting in learning at a relatively low SOLO level (The SOLO taxomony; Structure of Observed Learning Outcomes, Biggs & Tang (2011)). In addition, the applied TLA's were often solved by finding the answer directly in the text book with no re-thinking or reflection. The assessment consisted of four multiple choice exams ensuring the student to be focused during the course, but unfortunately also resulting maintaining a low SOLO level. It was therefore decided to change the course ILO's with increasing complexity and to introduce TLA's in the teaching sessions facilitating more reflective thinking and interpretation skills. Furthermore, it was also decided to change the course to a MSc course with the idea that this will ensure a higher basic understanding of the biological and soil processes describing plant ecophysiological processes enabling to focus more

[1] Faculty of Sciences (2013). Kursusbeskrivelse Advanced Plant Ecophysiology 2013, URL: http://www.courseinfo.life.ku.dk/Kurser/LPLK10382.aspx

on detailed and complex scientific issues in according to the changed ILO's in the course description. The assessment structure was also changed, as two multiple choice exams were exchanged with an 2½ hour written exam with small assay questions evaluating students ability to combine and reflect upon their obtained knowledge.

Teaching and learning activities – special focus on "deep learning" cases

In the 2013-course, I was responsible for half a day of teaching in two subtopics; i) Acquisition of micronutrients and micronutrient efficiency and ii) Tolerance to acid and calcareous soils. I constructed five ILO's with verbs from the SOLO taxonomy which were presented at the end of the lecture. There are several levels of understanding illustrating the learning outcomes in relation to their complexity. The five ILO's for my lecture were:

- *Understanding* of strategy I and II mechanisms *enabling you to design* nutrient efficient intercropping productions.
- *Obtain insight* into micronutrient interaction as well as physiological and molecular mechanisms involved in micronutrient efficiency *enabling you to design* micronutrient efficient genotypes.
- *Achieve detailed knowledge* regarding the consequences of soil acidification on soil fertility as well as the physiological and biochemical consequences of aluminium toxicity.
- *Acquire complete understanding* of the mechanisms involved in aluminium tolerance for different plant species *enabling you to design* aluminium tolerant plant genotypes.
- *Be familiar* with the characteristics of calcicole species.

I used verbs from the unistructural phase (*be familiar, obtain insight, achieve information, acquire understanding*) which were combined with verbs from the extended abstract level in the qualitative phase (*design*). Initially I did not show the ILO's directly but presented them as modified check points to illustrate the sub-topics for the lecture and let them re-think and combine knowledge using their own terms and capacities based on the initial lecture and home-reading of text-book instead of utilizing the leading-statements listed in the ILO's. As the majority of the students came from Department of Biology, I was not familiar with the knowledge prerequisites of the students. The intention was then to have an initial part of the lecture presenting some fundamental facts essential for understanding and reflecting on the more complex research topics. I therefore started the lecture with some basic definitions and questions to get a feeling regarding their scientific level. During the lecture, there was room for clarifying questions and I also made small questions for checking whether the students still were focused on the present lecture, e.g. a 3 minute sum-exercise regarding reflective thoughts on pros and cons of the Fe-deficiency induced mechanism just been presented. Right from the beginning of the lecture, I tried to make an informal atmosphere and stating that all questions and comments were welcome and that it is joint effort in terms of having an efficient learning session. After each introduction of the individual sub-topics, I have made several case-based exercises in which it was the intention that students should utilize the gained information to combine and reach an increased level of understanding within the two tub-topics. I have listed one example from each sub-topic, respectively (see Figure 15.2 and 15.3).

Case I: Intercropping of maize and peanut

1) Please analyse and interpret the data in table 1 and 2. Make a schematic drawing of the rhizosphere explaining the responses observed.

Table 1
Shoot dry weight, chlorophyll and the shoot concentrations of iron (Fe), zinc (Zn) and manganese (Mn) of peanut and maize grown as monocrops and intercrops

Cropping treatments	Dry weight (g plant^{-1})	Chlorophyll (mg kg^{-1} DW)	Fe (mg kg^{-1} DW)	Zn (mg kg^{-1} DW)	Mn (mg kg^{-1} DW)
Monocropping peanut	1.93	217	40.4	10.4	29.0
Intercropping peanut	1.30	228	107.9	26.2	33.4
F values	193**	45.38**	110**	14.0*	9.38*
Monocropping maize	1.77	128	34.4	46.1	69.7
Intercropping maize	1.37	141	46.3	31.0	62.0
F values	72**	33.80**	1.73^{ns}	6.05^{ns}	2.52^{ns}

The values are means of three replicates. *$P < 0.05$, **$P < 0.01$, ns, non-significant.

Table 2
Nitrogen (N), phosphorus (P), potassium (K) and calcium (Ca) concentrations of peanut and maize grown as monocrops and intercrops

Cropping treatments	N (g kg^{-1} DW)	P (g kg^{-1} DW)	K (g kg^{-1} DW)	Ca (g kg^{-1} DW)
Monocropping peanut	27.4	1.56	21.6	13.5
Intercropping peanut	29.3	1.84	29.8	11.1
F values	0.45^{ns}	10.3*	70.2**	20.7**
Monocropping maize	20.8	0.99	20.6	4.93
Intercropping maize	19.8	1.70	39.6	3.89
F values	0.57^{ns}	10.8*	9.64*	8.53*

The values are means of three replicates. *$P < 0.05$, **$P < 0.01$, ns, non-significant.

2) Which soil types would this cropping procedure be particular beneficial?

3) How does such a interaction affect the competition ability of individual plant species, the ecophysiological consequences?

Fig. 15.2. Exercise case-example for the sub-topic "Acquisition of micronutrients and micronutrient efficiency".

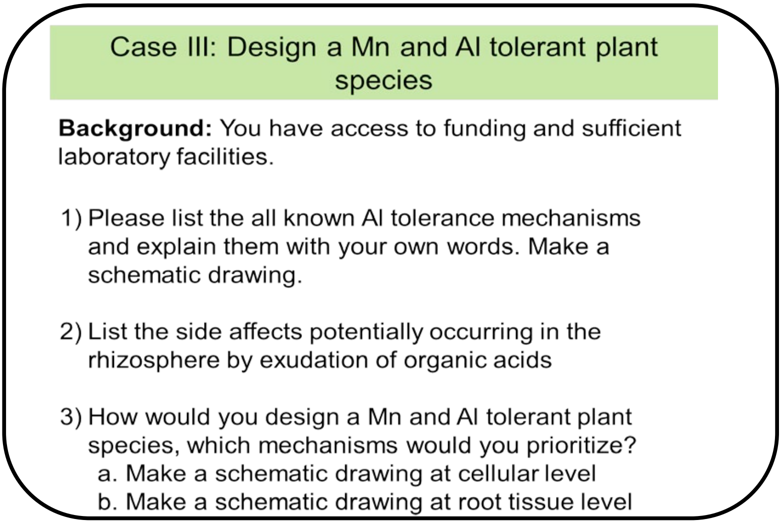


Fig. 15.3. Exercise case-example for the sub-topic "Tolerance to acid and calcareous soils".

For both cases the ILO's in this predominately student-active TLA were at the extended abstract level in the qualitative phase, trying to combine and utilize the presented information in for instance interpretation of data or designing hypothetical plant lines with increased tolerance for growing on specific soil types. At the introduction of the cases it was also stated that all answers were accepted as long as the students could argue with scientific arguments. In addition to this, the students were divided in two groups, each having the responsibility of individual cases resulting in the groups being inter-depended on each other's work-efficiency and quality. By doing this the students were very motivated and also forced to add an additional layer of reflection before being able to complete the cases. Finalization of the cases was done by either student presentation of case-responses at the blackboard or by me guiding through the cases with student responses from the class room. In both approaches, all answers and responses were not instantly confirmed or rejected by me, but I tried to involve all students in a dialogic manner until the individual topics/cases were sufficiently treated in relation to the ILO's for the whole teaching session. In this respect it is important that me as teacher did not interfere with the students (guidance but not answering strait away) so scientific doubt and discussion were allowed until the right answer or reflection appeared.

Evaluation and conclusions

After my day of teaching, all students were asked to fill out an evaluation form consisting of four questions:

- What did you learn that was new?
- Which questions relating to today's session are still left unanswered?
- What was good about the session today?
- Do you have any constructive criticism relating to today's session you would like to provide?

From this type of evaluation sheet, one can expect as many different answers as there are students. However, the relatively simple questions were used to acquire a fast evaluation regarding the lecture but just as important also to gain information regarding specific topics being insufficiently understood enabling the teachers to include a small specific re-cap in the next teaching session.

Unfortunately, only ten students were registered for course and eight were present in my lecture. In the beginning of the lecture it was relatively hard to get the students activated. This was unfortunately related to several major gaps in fundamental knowledge, which normally should be obtained in bachelor courses. This is not an uncommon observation in courses attracting students from other faculties or education programmes. However, I tried to lift their basic knowledge while maintaining the goal listed in the ILO's resulting in a fairly rapid pace in the lecture also being mentioned by a couple of students in the evaluation. After several TLA's in the lecture it seemed as the students were catching the scientific information and able to respond accordingly to my small questions and sum-exercises during the lecture. My use of case-exercises following the lecture was conducted with a high level of student activation, it seemed as all students were active, both during the group work but also during reviewing the case-responses at the end. In general, the case-exercises received very positive evaluations, student citation "the theoretical exercises were very good and served to elucidate some of the things which are very unclear in the book (e.g. strategy I and II iron uptake) – so that was very, very nice." From the discussion and case-responses we had in plenum, I could to a large extent tell that the students had achieved what I had intended they should learn. They were able to reflect on the obtained information and relate to presented scientific data, they could explain the processes and definitions and put them in context to varying natural conditions as well as being able to go beyond what we had discussed during the more formal part of the teaching. The scientific reflections and thoughts made in the class room were at a higher level than is stated and discussed in the text-book. At the final written assessment I have one question regarding processes involved in soil acidification and the causes of these. The majority of the students were able to extract the right processes followed by detailed explanations for the mechanisms involved. This summative assessment told me that the students had learned what I laid out in my IOL's for this specific sub-topic.

Perspectives

Even though that the students reported in the evaluation schemes that there was a good balance between lecturing and case-exercises, I would for the next course plan extra time for case-work as it was my impression that this type of TLA's was very efficient in obtaining efficient learning at a high SOLO level. This would require a more focused and aligned lecture with less details on sub-sub-topics. Pre-assignments could also be handed out involving the students before the lecture. In future courses it could be exiting to increase the deep learning by allowing more actual teaching time to be used for reflective case-work (theoretical and experimental) at the level of research grant applications so we get the students to contribute to forming a novel research hypothesis. More home-preparation will be needed in this case, for instance besides studying text material and study questions also E-lectures presenting the fundamental facts could be part of home-studying. Then the actual time at the University can be used for difficult exercises and scientific topics and stimulating the deep learning by increasing the scientific level in actual and relevant scientific cases. The challenging dilemma regarding the missing prerequisites of the students is also something which needs additional focus, especially related to the course now being MSc course only. It can be suggested that one session in the beginning of the course should be used to re-cap the most important fundamental knowledge needed for obtaining ILO's in the course description. However, as the course is a multipledisciplinary course this may very well be complicated to do whereas small adjustments in the individual lectures seem more applicable. In this aspect it is important that the overall SOLO level is maintained as it is the responsibility of the students to align their prerequisites with the prerequisites stated the course description.

16

Increasing Social Integration in an Interdisciplinary MA Programme through Group Work

Jakob Elming

Centre for Language Technology, University of Copenhagen

Introduction

In an interdisciplinary MA programme, it is especially important that the students get socially integrated from the beginning. Most often not only the place and people will be new but also the field of study. This can be difficult to handle without a network. In this project I will investigate using group work to help initiate social integration. In this context, I will also reflect on the different group work I conducted.

Challenge

A general issue in Danish higher-level education is that – contrary to recommendations in the Bologna process[1] – an MA programme is most often treated as a continuation of a BA programme and not as a new beginning. Therefore there is no introductory phrase where the students can get socially integrated.

I am teaching at the MA programme IT and Cognition (IT&C), which is not the natural continuation of any particular BA programme, such as e.g. an MA in linguistics would be a natural continuation of a BA in linguistics. As a consequence, the students have very different educational backgrounds (from philosophy to computer science) and come from all over the

[1] http://www.ehea.info/Uploads/(1)/Bologna%20Process%20Implementation%20Report.pdf

world (from China to the US), so they have very different prerequisites and do not know each other. Something that they do have in common, is that they need to form a new interdisciplinary identity and a new academic network. The course I am teaching is an introduction to the programme, and it is the first course the new students encounter.

Generally, social integration has been shown to have a positive impact on student success leading to less dropout (Tinto 1993). An academic network where you can discuss your subject outside class, is very important both for your level of learning and your perception of the programme. This will be even more outspoken for students moving to a new country and a new study field, where they inevitably will have caveats in their knowledge. All this makes it important to create a learning environment that encourages social integration.

Approach

I have chosen to experiment with group work – within and outside of the classroom – as a catalyst for social integration. The motivation for this is that it creates a forum where the students are encouraged to interact with each other and thereby get to know each other. Engstrom found that a contributing factor from group work was that "students developed a sense of community or family" (Engstrom 2008, pp. 12). Contrary to this, Braxton et al. (2000) to their own surprise do not find a significant correlation between group work and social integration. They however offer critique points to their own measurements in the light that other peer engagement does show a positive correlation.

Group work was also chosen because in class it can be a good teaching/learning activity to break up a lecture and activate the students. This may have a beneficial effect on the student's learning compared to a more passive lecture scenario. Rather than receding to a comfortable and safe role as spectator in class, the students are assigned co-responsibility for creating a productive learning environment.

The students are divided in study groups at the beginning of the programme based on diversity in background, but the teachers have previously not used these very actively. They are more thought of as a forum where the students can help each other at their own initiative. Last year many of these groups never took off, and the teachers were not in touch with how they were running. Most often the students need incentive to start using the groups. I will provide this by placing a major focus on group work around specific tasks in the course. This will also provide a more dynamic learning environment compared to pure lecture-based learning.

Biggs and Tang (Biggs & Tang 2011, pp. 165) note that a successful group work should be controlled by the teacher with an atmosphere where the students feel they can discuss uninhibitedly, and the students must be sufficiently prepared to be able to contribute to the group. It is therefore important to create a setting where the students know what they are supposed to do, and where the teacher is guiding the processes without interfering too much by validating, which can discourage the students from wanted to provide an answer themselves. In stead the teacher's role should be to lead the students in the right direction when they are stuck or have gone astray (Bolton 1999).

Implementation

Classes are two-hour sessions (90 minutes teaching). To obtain constructive alignment (Biggs & Tang 2011) with the final exam of the course, where the students should present a research paper and criticize it, there is a main focus on student presentations of research papers in each class. The 90 minutes are generally split in three 30-minute sessions to accommodate the fact that the attention span of adults doing something they find interesting, is no longer than 20 minutes (Cornish & Dukette 2009, pp. 73). Two of the 30-minute sessions will be allocated to group work:

1. **Lecture**. This session is a slide-based lecture presenting the topic of the day.
2. **Student presentation** of a research paper relevant to the topic. These sessions are based on the study groups. The presentation is prepared and presented by the entire group. Each group will make at least three presentations throughout the course. The rest of the groups upload two clarifying and an open research question for the paper to Absalon at the latest two days before class, so the other groups and especially the presenting group can be inspired by the other group's questions. Besides forming the basis for discussion after the presentation, this exercise also motivates the others to read the paper and discuss it with their group.
3. **Group assignment or an additional student presentation**. For group assignment, the groups will be presented with a problem that they have

to solve as a group. This could be explaining an algorithm so everyone in the group understands it and apply it to an example manually.

As a final group exercise we use the two final classes for a **group workshop** where the groups focus on a research paper and create a research plan for an experiment to extend the work done in the paper. This plan is presented and discussed in class on the second day.

Evaluation

The group work is evaluated using introspective judgments from the students gathered through a questionnaire. Appendix A contains the questions and the student response. Out of a total of 24 students, 20 replied to the questionnaire. The questionnaire makes the students reflect on different aspects of the group work conducted throughout the course: 1) **group paper presentation**, 2) **group assignment**, 3) **group work shop**, and 4) **overall group work** during the course. In addition to the judgements, students were also able to create individual comments, which quite a few did (between 5 and 12 comments per question).

Analysis and Discussion

From the student response, there is very high agreement that the group work was a helpful factor in initializing social integration (on average students agree/strongly agree that "group work helped me get to know my new fellow students"). In hindsight it would have been interesting to ask the students how important social integration is to them and their education as a supplement to the correlation.

Group work is however only one initiative to initiate social integration, and it should not stand alone. From the comments provided by the students in the questionnaire and through personal conversation, it seems that the many students have become integrated with the other students in their group but not integrated in the rest of the class. As an example for further initiatives, Braxton et al. (2000) suggest that faculty classroom behaviors and active learning in general has an influence on social integration. Also it might be a good idea to reassign the groups every semester to create new connections.

Looking at the different types of group work conducted, the students were generally on the positive side of the scale. For *group paper presentation*, the students were generally positive towards the group work and felt they learnt something from the preparation and presentation part. They were less positive about the question preparation. This probably reflects that the questions were not utilized in the best way in class, where they were meant as a basis for discussion, so the students should bring them up themselves. This lack of control had a negative influence. Many students comment that they did not prioritize this very high, felt it was not used in the best way, or split up the work to individuals. In the future, one modification to accommodate this might be to have a single designated opponent group creating questions for the presenting group. A general issue for *group paper presentation* was that the repetitiveness of the exercise seemed to introduce fatigue. Experiencing the same group work every week for a semester becomes predictable, and at the end student engagement seemed to decline.

Most of the students were happy with the *group assignments*, which were assignments that I felt worked really well. The main comments from the students were that they did not posses the skills required yet at that stage. I was not aware of this the first time, so I modified the assignment. Another problem was that 30 minutes was not enough, and often the students did not finish the task. In the future, I would assign more time to the sessions.

The *group work* shop was also received well by the students. Some comment that it was a more interesting task than merely presenting a paper, or that the session showed them that they had learnt a lot during the course. Others felt they would have liked more validation to resemble the exam more.

A surprising response was that the students did not feel it helped being in mixedbackground groups. Many comment that they did not notice this very much, and others felt they were imposing on the others if they had difficulty keeping up. Some however write that they gained a lot from being able to draw on the strength of the others. I still believe that the mixed groups are to be preferred over group similar backgrounds together.

Conclusion

In conclusion, the students were very positive towards the group work. They both felt it improved the class and their learning. Also it did seem to have a positive effect on social integration, which I believe is very important in an interdisciplinary programme. It is however important to keep thinking of the learning objective of the sessions, so the group work doesn't just become an unconscious reflex, but has a purpose that makes sense in the exact situation it is being deployed.

A Questionnaire and Response

The table below represents the questionnaire sent to the students and their response. The questionnaire uses a Likert scale for the students to judge the statements on the left. The *Mean judgment scale* is an average over all judgments where 1 is *strongly disagree* and 5 is *strongly agree*.

Group Paper Presentation							
Questions. The following statements concern the group work of formulating questions for the other presentations.							
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	I did not attend	Mean judgement scale
Our group worked well together in creating the questions	10%	15%	10%	45%	20%	0%	3,50
	2	3	2	9	4	0	
I learned a lot from these sessions	10%	15%	15%	40%	20%	0%	3,45
	2	3	3	8	4	0	
Preparation. The following statements concern the group work of preparing the presentation.							
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	I did not attend	Mean judgement scale
Our group worked well together in preparing the presentation	0%	10%	10%	35%	45%	0%	4,15
	0	2	2	7	9	0	
I learned a lot from these sessions	5%	0%	15%	55,00%	25%	0%	3,95
	1	0	3	11	5	0	
Presentation. The following statements concern the group work of presenting the paper.							
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	I did not attend	Mean judgement scale
Our group worked well together in giving the presentation	0%	5%	15%	35%	45%	0%	4,20
	0	1	3	7	9	0	
I learned a lot from these sessions	0%	10%	25%	30%	35%	0%	3,90
	0	2	5	6	7	0	

Group Assignment							
In class, we had four group exercises centred around the implementation of machine learning algorithms. Please indicate your response to the following statement about these sessions.							
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	I did not attend	Mean judgement scale
I enjoyed these sessions	0%	10%	15%	65%	10%	0%	3,75
	0	2	3	13	2	0	
I learned a lot from these sessions	0%	5%	30%	55,00%	10%	0%	3,70
	0	1	6	11	2	0	

Group Work Shop							
In the final classes, we had a group workshop session. Please indicate your response to the following statement about these sessions.							
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	I did not attend	Mean judgement scale
I enjoyed this sessions	5%	0%	10%	35%	30%	20%	4,06
	1	0	2	7	6	4	
I learned a lot from this session	5%	0%	5%	40%	30%	20%	4,13
	1	0	1	8	6	4	

Group Work throughout the Course						
Please indicate your response to the following statement about the group work.						
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Mean judgement scale
My group has been functioning well	0%	5,26%	15,79%	36,84%	42,11%	4,16
	0	1	3	7	8	
The group work made classes more interesting	0%	10%	5%	50%	35%	4,10
	0	2	1	10	7	
The group work increased my learning	0%	10,53%	21,05%	36,84%	31,58%	3,89
	0	2	4	7	6	
The mixed academic background of our group members helped my learning	5%	30%	15%	30%	20%	3,30
	1	6	3	6	4	
The group work helped me get to know my new fellow students	0%	0%	10%	35%	55,00%	4,45
	0	0	2	7	11	

17

Challenges associated with teaching interdisciplinary courses - Getting the level right and increasing student's active participation in classes

Thilde Bech Bruun

Department of Plant and Environmental Sciences, University of Copenhagen

Introduction

During the last four years, I have been teaching on two interdisciplinary Master's level courses ('Tropical Crop Production' and 'Thematic Course in Interdisciplinary Land Use and Natural Resource Management') that are both hosted at Department of Plant and Environmental Sciences. Both courses are followed by students with very diverse disciplinary backgrounds. My experiences from teaching these two courses have made me reflect on the challenges associated with interdisciplinary teaching in an international context and encouraged me to experiment with methods to overcome these challenges.

This project takes point of departure in the challenges that I have faced while teaching the course in Tropical Crop Production and describes and discusses the measures that I have applied in attempt to overcome these challenges.

Challenges associated with teaching on the course in Tropical Crop Production

The course in Tropical Crop Production is a 7.5 ECTS points course, offered as a part of the master's programme in Agricultural Development. The course is followed by students with BSc degrees in a wide range of disciplines - e.g. Geography, Crop physiology, Agronomy, Biology, Natural Resources and Human nutrition and is mandatory for students under the AgrisMundus program. The students are a culturally diverse group which in 2013 represented 15 different nationalities (out of 25 students). 10 of these students were from developing countries. The course is taught in block one; hence it is often one of the first courses that international students are following at a Danish university. The teaching at the course is a mixture of lectures, theoretical exercises and practical exercises. Four lectures contribute equally to teaching the course.

One of the main challenges associated with teaching the course in Tropical Crop Production is related to the interdisciplinary nature of this course. Not only do the students have many different disciplinary qualifications, but the qualifications change from year to year, hence it is difficult to know the level of background knowledge the students in a certain year have on a certain subject and to adjust the level and nature of the teaching accordingly. Of course the teaching has to fulfil a certain minimum level, but as the course curriculum is very broad, there is also a great deal of flexibility in terms of which issues to focus on, the level of detail and on how much to deviate from the course literature during lectures. Dealing with the challenge of getting the level right is one of the main focuses of this project.

A second challenge is related to the fact that the course for many international students is the first encounter with the Danish university system and the Danish teaching style. As many of the students are from developing countries where university teaching is dominated by a well maintained hierarchy and one way communication, it can be particularly difficult to make these students participate actively in the classes. Improving the student's active participation in the lectures and exercises is another focus point of this project.

Problem statement

The objective of this project is to explore and evaluate methods to improve the lectures and exercises on the course in Tropical Crop Production.

In particular, the project investigates how an initial screening of the student's background knowledge and interests within selected topics can be used to ensure an **appropriate level** of the lectures and to increase the student's engagement in the teaching. Moreover, the project investigates if selected tools can be used to **increase student's active participation in classes**.

The expected outcome of the project is to be able to make course adjustments that facilitate deep learning by student activating teaching at an appropriate level.

Due to the absence of systematically collected baseline data that the results of the applied methods can be compared with, and because of the central KU course evaluation system was not functioning, the evaluation of the applied methods will mainly be done in a qualitative basis and based on my own experience, students' feedback and answers from the written exam.

Initial screening of knowledge and areas of interests

In order to get an impression of the student's background knowledge and areas of interests as fast as possible, I developed a short questionnaire that was distributed on the first day of the course. The questionnaire was developed using the freeware version of Survey Monkey.

The questionnaire contained four main kinds of questions:

1. Conceptual questions about specific topics.

   The purpose of these questions was to screen the student's background knowledge about central concepts, in order to decide how much time I should allocate to explaining these – and which level to start from. Moreover, I expected that the wording and the vocabulary that the students would use when replying these questions, would add to my knowledge of their level of understanding.

2. Questions about which specific issues the students would like me to focus on during selected themes. The issues were divided into predefined categories, but with the option of suggesting issues that were not mentioned in a comment box.

   The idea with this type of questions was to give the students a chance to influence the topics of my teaching whenever this was possible in order to make the teaching as relevant and interesting as possible.

3. Questions in which the students were prompted to ask a question about a specific topic.

    The purpose of these types of questions was twofold: 1. to make the students start thinking about the topics and 2. to give me an idea about how to make the teaching as relevant and inspiring as possible by focussing on issues that the students found interesting.

4. Self-rating of knowledge of certain topics.
    These questions were meant as a supplement to the type 1 questions and at the same time the answers would provide a quantitative measure of the level of knowledge.

The questionnaire was presented during the first day of the course and I made sure to explain the purpose of the questions in an honest way and made an effort out of explaining that even though they may not know the exact answers to the conceptual questions, they should still try to write an answer as it would be very useful for me to see the vocabulary they would use. I explained that there was a certain degree of flexibility in the curriculum of some of my lessons and that I would take their answers into consideration when deciding the content of these lessons. I also emphasized that the questionnaire was anonymous and that the results would be used to improve the teaching so there would be absolutely no point in wasting time on looking up the answers even though this could be easily done. The questionnaire was distributed by email on the same day with a deadline of one week to reply. 22 out of the 25 students answered the questionnaire within the deadline.

The results of the questionnaire confirmed that the scientific level varied a lot among the students and showed that the level was generally lower than I had expected. This was very useful in the planning of lectures and helped me to identify topics that I had to explain at a higher level of details than I had done the previous years. I also decided to eliminate some of the most difficult aspects of certain topics from my lectures when realizing that only a couple of students would be able to comprehend these. The student's answers to the conceptual questions were extremely useful as they revealed that many students were not familiar with very central terms and concepts that I, therefore decided to spend some time on defining. In previous years I had just taken for granted that all students were familiar with these terms.

The students did to a large extend express interest in the same topics - in the answers to what they would like me to focus on as well as in the open questions. As these were not topics that I have spent a lot of time on the previous years this came as a surprise to me and led me to completely rethink two of the course days.

Discussion based teaching with point of departure in student defined subjects

One of the course days that I decided to rethink, was about 'Fertility of Tropical soils' - a day that is normally dedicated to lectures and calculation exercises. I planned to spend most of the day (three hours) on discussing one of the questions that many of the students had asked in the questionnaires, namely 'How to improve the fertility of degraded soils?'. Inspired by lectures and discussions at KNUD and IUP, I tried to design a discussion based course day during which the students did problem oriented group work about different issues related to improvement of soil fertility of degraded soils within small scale tropical farming systems. The group work was based on open questions relating to a loosely defined farming system, hence there were no 'right' and 'wrong' answers as such, but plenty of room to discuss different options and under which conditions (socio-economic, bio-physical and institutional) the different options would be appropriate and what the constraints to adoption would be. This lead to a very lively discussion in which all the students participated with theoretical knowledge or with practical examples. My role was merely to be a facilitator of this discussion and to make a final wrapping up and institutionalization. Apart from obtaining knowledge about different soil fertility management options, an important learning outcome of the lesson in 'Fertility of Tropical soils' is to gain awareness of the complexity of the issue. This outcome was certainly fulfilled which is evident from the answers from the written exam, that reveal a much higher level of reflection on this issue than I have seen the previous years (at a general level). After the discussion, I made a feed-back note based evaluation of the day and it was clear that the majority of the students felt that the discussion had been interesting and enriching. It was also clear that the combination of the loose format (that made it possible for students to contribute with knowledge based on their scientific background) and the fact that many students felt that they had defined the topic of the discussion themselves, was appreciated.

Student activating measures

In previous years, I have experienced that some students on the TCP course have been reluctant to ask questions during classes – especially in the beginning of the course and especially students from developing countries. Students have, however, not been reluctant to approach me to ask questions during the breaks. The reluctance to ask questions in plenum in the beginning of a course can be ascribed to several factors e.g. the fact that many students are in a completely new setting hence are not familiar with the Danish way of teaching and do not know any other students in the class. It may also have something to do with the interdisciplinary setting in which many students may be afraid of exposing their own lack of knowledge about a particular topic thinking that everyone else in the room knows the answer (which may to some extend be true in an interdisciplinary context).

In order to address the reluctance to ask questions in plenum and to increase student's participation in general, I experimented with different methods that we have been discussing during Adjunktpædagogikum and that are suggested in the literature (Biggs & Tang 2011, Liebman 1996). My aim was to make an extra effort to create a safe teaching environment and to use the fact that the students have very different scientific backgrounds in a positive way and try to create an interdisciplinary synergy.

During my second lecture, I presented some of the results of the questionnaire to show the students how much their levels of background knowledge within different topics differed and I also allocated more time than normally for the students to present themselves and their reasons for taking the course. This was done in attempt to make the students aware of the disciplinary heterogeneity of the class hypothesizing that this would make the individual student more confident and to make the students aware that it was perfectly ok to ask questions that other students were able to answer. I also used this opportunity to identify students with practical experience with tropical farming systems and asked them to prepare short presentations of the systems that they were familiar with whenever this was relevant. I see this as a way to exploit the interdisciplinary and international setup of the course while at the same time adding variation to the teaching and activating students that are normally not among the most active (students that have experience with tropical farming systems are normally from developing countries that are typically not among the most outspoken students). At the same time this was a way of signaling that comments based on practical experience is highly appreciated at the course – with reference to students who may not be so theoretically strong, but may have a lot of experiential knowledge that others could benefit from.

During lectures with a conceptually difficult content, I experimented with small sessions in which the students were asked to ask their neighbor a question about something that I had just talked about and if the neighbor was not able to answer the question they were encouraged to ask it in plenum. Apart from learning aspect associated with thinking about how to explain a given question, the testing of a given question on the neighbor clearly made the students more confident to ask questions in plenum. Moreover, the contact with the neighbor encouraged the students to talk with each other, which – I think – contributed to a fast creation of a safer learning environment. I also experimented with another variant of this method in which the students were asked to explain the most important aspects of the part of the lecture that they had just heard to the neighbor. The purpose of this was to make students process and reflect on the received information and to give them a chance of asking questions if something turned out to be unclear.

The students did in general take the exercises that involved contact with the neighbor very seriously and in the lectures where I applied the described methods, I certainly got a lot more questions in plenum than normally and not a single question during the break. I had planned to include a formal evaluation of the 'talk to your neighbor' method in the KU evaluation form, but due to technical problems with the evaluation system, this never happened.

Reflections

I will certainly apply the 'pre-screening of knowledge' questionnaire again next year. The answers have in many ways been very useful and inspiring in the planning of my teaching and it is my clear impression that the students appreciate to have a saying in the content of the classes and that this has a motivating effect (which was confirmed by student's feedback). I will also continue to work with different variations of the 'talk to your neighbor' method that I found very fruitful and very well suited for the course. It is difficult to say if the adjustments that I applied in the course this year made the students from developing countries participate more actively than they would otherwise have done. As mentioned, I got a lot more questions during the lessons than in previous years and the level of participation from all students were certainly higher than in previous years. I also noted that there was a very pleasant and relaxed atmosphere among the students. But it is also my impression that the 2013 class was particularly active and motivated this year which has been confirmed my colleagues who did not make any attempts to increase the participation this year.

18

Promoting Active Participation in Computer Science Lectures

Stefan Sommer

Department of Computer Science, University of Copenhagen

Introduction

The B.Sc. course “Data Analysis” (“Dataanalyse”), Department of Computer Science, University of Copenhagen, aims at enabling students to solve data analysis problems using methods from signal processing, statistics and machine learning. The focus on problem solving skills is reflected in the intended learning objectives (ILOs), and the students solve actual data analysis problems during the course in written assignments. However, in the lectures, the learning activities have mainly consisted of traditional one-way lecturer-to-student communication.

Several problems with classical lectures limit the learning outcome, including the fact that students are mainly passive listeners and that the amount of interaction between students and lecturer is low. In addition, as previously identified (Sommer 2013), the learning activities in the lectures in “Data Analysis” are not in alignment with the ILOs and the assessment criteria; the lectures do not focus on enabling the students to actually solve data analysis problems.

Problem Statement

In this project, I will investigate ways of promoting active participation in the lectures in “Data Analysis” in order to both align the learning activities with the ILOs and the assessment criteria, and to increase the learning outcome among the students. I will in particular focus on ways of making the students perform data analysis tasks in the lectures and on how the results of these tasks can be used for initiating discussions. The effect of changing the learning activities will be evaluated and discussed based on written feedback from students attending the lectures.

Lectures and Student Activation

The inherent problems with traditional lectures are described thoroughly in the literature, see e.g. (Gibbs 1981) and (Rienecker et al. 2013, chap. 4.1). Among the major issues is the one-way communication from teacher to student that results in the students passively listening to a presentation instead of actively working with the content. It is very hard for the lecturer to target the teaching for the actual students, both because the students will have very different prerequisites (Rienecker et al. 2013, chap. 1.1) and because feedback from students to lecturer is at best sparse. The high involvement of students that is the focus of problem based teaching and problem based learning (Rienecker et al. 2013, chap. 4.3-4) is almost contrary to the classical lecture.

In the course “Data Analysis”, the above issues are complemented by the fact that the lectures do not teach the students what they should learn; actually solving data analysis problems (see course description page in appendix A). A very concrete reflection of the problems with the previous structure of the lectures and learning activities is the fact that less than half the students of the course attend the lectures.

Promoting student activation in lectures is the subject of texts such as (Mazur 1997). Here it is proposed to structure the lecture around problems that students are asked to solve and discuss in pairs during the lecture. Following this, answers can be discussed between lecturer and students. This approach has several benefits, including that students are actively working with the material, that the lecturer receives feedback from the solutions to questions, and that discussions following the questions can address the parts of the subject that students actually find hard. In traditional lectures, the presentation in the textbook is often repeated in the lecture. With the structure proposed by (Mazur 1997), this problem is alleviated by involving the students in both solving problems and, using the repeated feedback, targeting the presentation towards the student’s needs.

Case: Datanalyse 2014

In order to increase student participation and align the lectures with the course ILOs, I will use the lectures “Classification 1” and “Classification 2”, both 2 x 45 minutes, as the case for testing and evaluating a teaching method inspired by (Mazur 1997). The intend is to design the lectures to have a greater focus on student participation and discussions. The outcome of the changed teaching approach will be evaluated with written evaluation following the second lecture.

In order to best address the learning objectives, the students should participate in formulating, executing, and discussing steps in solving a data analysis problem. The fixed 2 x 45 min. lecture format does not allow time for both defining a problem in its entirety, implementing computer code for the analysis, and discussing the results. Instead, I wish to give the students experience with handling the different steps of the analysis process within the time-frame by focusing on subparts of the problem solution process. As a general rule, the intend is that each part contain a question for the students, that the students have time to think of an answer and discuss in pairs (3 min.), and that this is followed by a discussion of the answers between students and lecturer and related to additional theory. The structure implies shift from the lecturer covering a large topic in detail to a focus on fewer, selected parts of the material.

Example Lecture: Data Analysis Classification 1

Below is an outline of the first of the two redesigned lectures. The lecture starts with a discussion with the students of the ILOs and their relevance. The lecture ends with a discussion on to which degree the ILOs have been addressed in order to guide the students in their study after the lecture. Both parts are introduced to established a “didactical contract” with the students.

Part 1 (45 min.)

0-2 min. Welcome: Todays lecture, structure and content.
3-7 min. Discussion of ILOs and relevance.
8-11 min. Discussion of examples of classification tasks.
12-14 min. 3 min. question: structure of a classification problem.
15-26 min. Discussion of answers and summary on blackboard.
27-34 min. Examples in MATLAB and discussion of visualization.

35-37 min. 3 min. question: geometric examples of classification.
38-45 min. Discussion of answers and summary on blackboard.

Part 2 (45 min.)

0-2 min. 3 min. question: qualitative and quantitative measures of performance of classification functions.
3-14 min. Discussion of answers and summary on blackboard.
15-17 min. 3 min. question: training and test of classification functions.
18-29 min. Discussion of answers and summary on blackboard.
30-32 min. 3 min. question: pseudocode for cross-validation algorithm.
33-40 min. Discussion of answers and summary on blackboard.
41-45 min. Summary and discussion of ILOs.

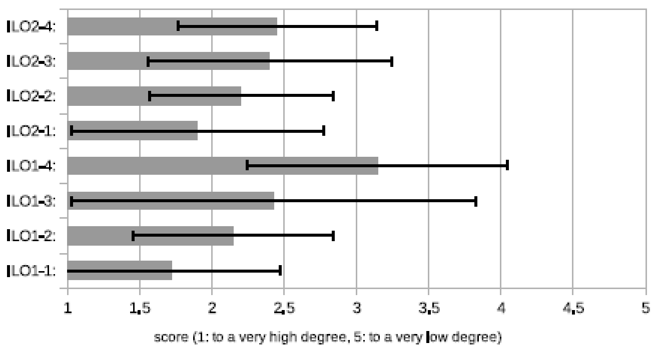


Fig. 18.1. Student responses: To which degree did the lectures make you able to meet the ILOs 1-1 to 1-4 (lecture 1) and ILOs 2-1 to 2-4 (lecture 2).

Note that the general structure is a sequence of questions that the students have 3 minutes to answer and discuss in pairs. Following each question, we discussed the answers together and students came to the blackboard to illustrate their solutions. We summarized the discussions and related them to the rest of the theory by treating smaller questions and by structuring the answers on the blackboard.

Evaluation and Results

In addition to the continuous feedback I received from discussing with the students during the lectures, the students were asked to evaluate the learning activities in a questionnaire at the end of the second lecture, see appendix B. The questionnaire focused on evaluating to which degree the changed teaching style helped the students in meeting the ILOs (Figure 18.1). In addition, the students were asked to evaluate the new learning activities in comparison with the previously taught traditional lectures (Figure 18.2).

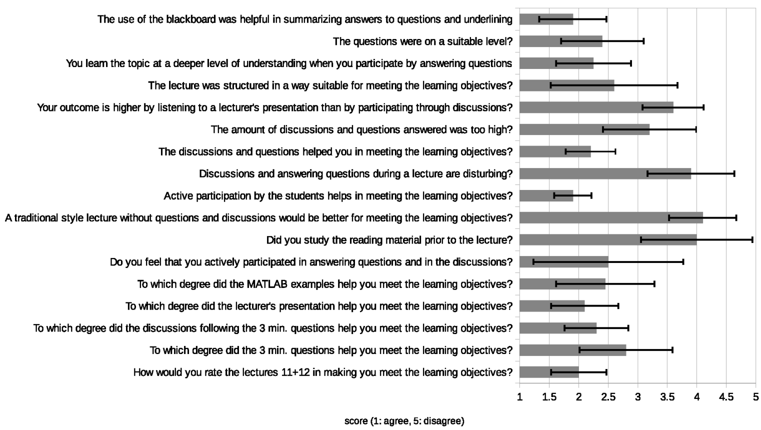


Fig. 18.2. Student evaluation of the change in teaching method and of involving students in the lecture trough questions and discussions. The responses indicate that students generally feel their learning outcome is higher with the question/discussion based lectures.

The ten students present at the second lecture answered the questionnaire. The student's own perception of to which degree the lectures helped them meeting the learning objectives is moderately positive.

The student's evaluation of the changed learning activities indicate that they find that their learning outcome has increased. Responses to questions such as "Active participation by the students helps in meeting the learning objectives?" are positive (mean < 2 on the 1-5 scale). The students in addition answer that they feel they obtain a deeper level of understanding by actively participating in the lecture. To a high degree, they favour the changed lecturing style for meeting the learning objectives.

There is a more positive rating of the learning outcome from the lecturer's presentation than from the questions and discussions though none of the factors are rated negatively.

Some students indicated in their comments that they felt the amount of questions and discussions where too high though the general response to the question "The amount of discussions and questions answered was too high?" is neutral.

Discussion

The evaluation was performed by a small fraction of students on the course. Though the ten students are not representative of all students of the course, the responses represent the evaluation by students actually participating in the lectures. Had the lower number of attendees been known prior to the planning of the project, an interview based or oral evaluation would likely have been more informative. The low attendance at both lectures and exercise sessions is a general problem for the computer science bachelor courses. It can be speculated that an improved learning outcome with the more interactive lectures will make the lectures more relevant for the students and thus increase attendance. This can be tested if the changed teaching style is applied to all lectures next time the course is taught.

Though the students generally respond positively to the degree by the which the lectures have enabled them to meet the ILOs, lacking similar responses from lectures with the traditional teaching style, it is hard to conclude on any effect of the changed structure. It should be noted that "novelty-effects" can be the cause of the positive responses to the changed structure.

The fact that there is a more positive rating of the learning outcome from the lecturer's presentation than from the questions and discussions can be linked to the presentations being improved by the continuous feedback provided by the questions and discussions. I generally felt that the continuous feedback helped me greatly in targeting the presentation and use of the blackboard to address parts of the subjects where the students needed more elaboration. The communication where two-ways throughout both lectures which I felt made the presentation work much better.

The students where very active in the discussions and in answering questions that other students asked. The atmosphere were in general less formal than the previous lectures, and the students seemed more open to asking questions. These questions clearly revealed areas that needed more elaboration, and the questions therefore served as guidance for where I should focus. I experimented with having other students in the class answering questions. The students were able to explain the material in different words, and the combination between my explanations and that of other students seemed to work very well in making hard parts clear.

The continuous feedback was challenging to handle as it forced me to change my plan for the lecture several times during the lecture. My planning served more as a rough idea of what the lecture could focus on which I then used to shape the content as needed.

It is my impression that the discussions of the ILOs in the beginning and end of each lecture worked well in aligning expectations with the students of how the ILOs could best be achieved (the "didactical contract"). In particular, it took focus away from what I as a teacher should provide the students and instead emphasized what the students should do in order to meet the ILOs. In addition, we discussed the importance of the ILOs thus making the relevance of the material clear early in the lecture.

Conclusion

There is a general consensus in the literature that the classical lecture does not result in optimal learning outcome. In addition, the lectures in "Data Analysis" have previously been found not to be in alignment with the ILOs. To address these issues, a changed lecture structures based on (Mazur 1997) was designed where the teaching activities were build around questions that students answer during the lecture followed by discussions of their answers.

Based on written evaluation in the form of a questionnaire, the student's responses to the changed teaching method is positive. They are positive towards the increased amount of participation and indicate that it results in increased learning outcome.

Though it was a challenge planning the interactive lectures, I believe based on the evaluation and from the continuous feedback during the lectures that they improved the learning outcome significantly. I will employ a variation of this format in all my future lectures.

A Course description of "Dataanalyse"

Courses

NDAK13002U Dataanalyse (DA) **Årgang 2013/2014**

Engelsk titel
Data Analysis (DA)

Kursusinformation

Sprog	Dansk
Point	7,5 ECTS
Niveau	Bachelor Kandidat
Varighed	1 blok
Placering	Blok 4
Skemagruppe	C
Kursuskapacitet	Ingen begrænsning
Efter- og videreuddannelse	
Studienævn	Studienævn for Matematik og Datalogi

Udbydende institut
- Datalogisk Institut

Kursusansvarlig
- Aasa Feragen (aasa@diku.dk)

Undervisere
Sami Sebastian Brandt og Stefan Sommer
Gemt den 08-11-2013

Uddannelse
Bacheloruddannelsen i datalogi

Kursusindhold
Formålet med kurset er at give en grundlæggende og bred introduktion til repræsentation, analyse og behandling af samplet data; at introducere den studerende til simple statistiske analyser af eksperimentel data samt data visualisering. Eksempler tages fra den virkelige verden såsom målinger af internettrafik, aktiemarkedsdata eller forbrugerdata, digital lyd og billede, osv. Endvidere gives en introduktion til programmeringsværktøjer til dataanalyse.

Kurset vil indeholde:

- Introduktion til databehandling og -filtrering.
- Sampling, samplet data frekvensrepræsentation.
- Sandsynlighedsregning og statistik, Bayesisk inferens.
- Parameterestimering, mindste kvadraters metode, lineær regression, matematisk modellering.
- Multivariat statistik, pricipalkomponentanalyse.
- Præsentation af analyseresultater inklusive visualisering med simpel plotting.
- Introduktion til MATLAB.

Målbeskrivelser
Viden

Den studerende vil have kendskab til dataanalysemetoder omfattende datarepræsentation, filtrering, modellering og estimering samt visualisering.

Færdigheder

Den studerende vil være i stand til at:

- Vælge en passende datarepræsentation og transformere mellem rum/tid- og frekvensdomæner, filtrere i både rum/tids- og frekvensdomæner.
- Anvende sandsynlighedsteori og statistik til problemer med skalar- og vektorværdier.
- Anvende mindste kvadraters metode til lineær modellering og estimering.
- Analysere samplet data med passende matematiske modelleringsværktøjer.
- Beskrive udvalgte multivariatmetoder og deres anvendelse, specifikt principalkomponentanalyse (PCA) og

denne brug i dimensionsreduktion.

- Visualisere lav- og højdimensionel data med simple plot og billeder.
- Implementere simple dataanalyse og -modelleringsmetoder.
- Udføre analyse af eksperimentel data med brug af de i kurset lærte metoder og evaluere resultaterne deraf.

Kompetencer

Den studerende vil være i stand til at udføre grundlæggende dataanalyseopgaver omfattende modellering, visualisering og fortolkning af resultater samt vurdere metodernes begrænsninger.

Undervisningsmateriale

Se Absalonsiden.

Undervisningsform

Forelæsninger, praktiske øvelser og obligatoriske opgaver.

Faglige forudsætninger

DIMS eller MatIntro, LinAlg, OOPD og SS.

Tilmelding

Via STADS selvbetjening

Eksamen

Point	7,5 ECTS
Prøveform	Løbende bedømmelse Eksamen består af en løbende bedømmelse af 4-6 hjemmeopgaver. Opgaverne vægtes lige.
Hjælpemidler	Alle hjælpemidler tilladt
Bedømmelsesform	7-trins skala
Censurform	Ingen ekstern censur Flere interne bedømmere
Reeksamen	20 minutters mundtlig eksamen uden forberedelse men med hjælpemidler.

Kriterier for bedømmelse

Se målbeskrivelsen

Arbejdsbelastning

Kategori	Timer
Forelæsninger	32
Teoretiske øvelser	72
Praktiske øvelser	72
Forberedelse	30
I alt	206

Gemt den 08-11-2013

B Evaluation of lectures 11+12 (Classification 1+2), Datanalyse 2014

Intended Learning Objectives:

Scale: 1 (to a very high degree), 3 (neutral), 5 (to a very low degree):

Did lecture 11 (Classification 1) make you able to ...

- formulate a classification problem

  1 2 3 4 5

- apply classification algorithms to concrete data

  1 2 3 4 5

- explain errors in terms of geometric properties of the applied algorithms

  1 2 3 4 5

- make a quantitative assessment of results using cross validation

  1 2 3 4 5

Did lecture 11 (Classification 2) make you able to ...

- evaluate if the learning algorithm is overfitting or underfitting

  1 2 3 4 5

- tune a classification algorithm using nested cross validation

  1 2 3 4 5

- identify relevant parameters for main classifications algorithms

  1 2 3 4 5

- select appropriate algorithms for datasets with different properties

  1 2 3 4 5

Outcome of Lectures:

How would you rate the lectures 11+12 in making you meet the learning objectives?

Very good Good Neutral Bad Very bad

To which degree did the 3 min. questions help you meet the learning objectives?

Very high degree High degree Neutral Low degree Very low degree

To which degree did the discussions following the 3 min. questions help you meet the learning objectives?

Very high degree High degree Neutral Low degree Very low degree

To which degree did the lecturer's presentation help you meet the learning objectives?

Very high degree High degree Neutral Low degree Very low degree

To which degree did the MATLAB examples help you meet the learning objectives?

Very high degree High degree Neutral Low degree Very low degree

Do you feel that you actively participated in answering questions and in the discussions?

Very high degree High degree Neutral Low degree Very low degree

Did you study the reading material prior to the lecture?

Very high degree High degree Neutral Low degree Very low degree

Do you agree that ...

... a traditional style lecture without questions and discussions would be better for meeting the learning objectives?

Fully agree Agree Neutral Disagree Fully disagree

... active participation by the students helps in meeting the learning objectives?

Fully agree Agree Neutral Disagree Fully disagree

... discussions and answering questions during a lecture are disturbing?

Fully agree Agree Neutral Disagree Fully disagree

... the discussions and questions helped you in meeting the learning objectives?

Fully agree Agree Neutral Disagree Fully disagree

... the amount of discussions and questions answered was too high?

Fully agree Agree Neutral Disagree Fully disagree

… your outcome is higher by listening to a lecturer's presentation than by participating through discussions?

Fully agree Agree Neutral Disagree Fully disagree

… the lecture was structured in a way suitable for meeting the learning objectives?

Fully agree Agree Neutral Disagree Fully disagree

… you learn the topic at a deeper level of understanding when you participate by answering questions and by taking part in the discussions?

Fully agree Agree Neutral Disagree Fully disagree

... the questions were on a suitable level?

Fully agree Agree Neutral Disagree Fully disagree

… the use of the blackboard was helpful in summarizing answers to questions and underlining important concepts?

Fully agree Agree Neutral Disagree Fully disagree

What do you like about the lectures 11+12:

____

____

____

____

What do you dislike about the lectures 11+12:

____

____

____

____

Why do you think that only less than half the students of the course attend the lectures:

____

____

____

____

19

Improving teaching activities in a classical journal club session - Activation and involvement of a larger number of students

Lisbeth Rosager Poulsen

Department of Plant and Environmental Sciences, University of Copenhagen

Introduction and Problem

In resent years the total number of students at several educations is increasing. A result of this fact is that in some cases the teaching styles used in the compulsory courses need to be adjusted to be able to handle larger classes while still fulfilling the intended learning outcome for the course. One of the educations in which this holds true is the BSc education Biology-biotechnology wherein I am involved as a teacher in one of the compulsory courses, more specifically the course “Experimental Molecular Biology”. The course consists of a mix of lectures, laboratory exercises and journal clubs. In this project I will only focus on what problems the increase in student number might cause for the journal club part and how these problems may be solved.

Journal club as a teaching style

A journal club has been defined as a situation in which a group of people meet to discuss research papers related to a certain research area, providing a forum to discuss and be updated in new or in many cases just relevant literature within a specific subject in this way being taught critical reading skills (Linzer 1987).

There are several arguments for why journal clubs are being used as a teaching style for both undergraduate and graduate students. It is a teaching style where the students will develop abilities within critical thinking while practicing interpretation of experimental design and data. In this way illustrating how the students can adapt the experimental methods in their own work. Finally but not least, it is a good way to introduce the students to primary literature (McDonough 2012, Murray 2013).

What is the intended learning outcome from the journal club?
In general one can say that journal clubs will help the student become more familiar with advanced literature within a certain research area. In addition, the students will be trained in debating current topics within the chosen area and gain deeper understanding of the topics.

More specifically for the course "Experimental Molecular Biology" the intended learning outcome of the journal club part is: "*Acquire skills in critical examination and interpretation of scientific data; gain a theoretical background for the experimental exercises; practice oral communication of scientific concepts and learn to describe basic theoretical aspects of scientific research methodology*", for more detail see course description (http://kurser.ku.dk/course/lbif10208u/2013-2014).

Limitation of the use of traditional journal club as a teaching style

In a classical journal club the session consists of a presentation (individual/group) followed by an in-plenum discussion of one to several scientific papers. Thus, it can be discussed how many persons a "club" can consists of (especially in a teaching situation) while the intended learning outcome still can be reached. The class size also affects whether all students will take part in the discussion and for the teacher to be able to assess whether the learning outcome has been met. What the optimal number of students is in a journal club situation may vary between different situations, but my personal feeling is that when more than 20 students are present the overall outcome will decrease. Just the fact that students often feel insecure talking out loud in a big crowd can negatively affect the journal club situation. The students are afraid to show fellow student as well as the teacher what they do not understand. In addition, they might be unsure of how to fraise a specific question.

Current and future journal club situation in the course "Experimental Molecular Biology"
This year 39 students attended the course but within a few years the student number will increase to approximately 70. Currently the journal club is structured such that one group (4 students) are presenting one scientific

paper while an opponent group (4 students) will give feedback on the presentation and at least start the following in-plenum discussion. Each journal club takes two hours. Within these two hours one scientific paper is being discussed. Currently there is in total 10 journal clubs (10 papers), meaning all groups will present and be opponent once.

We have in the teacher group discussed the situation and briefly talked about the problem with the increasing student number. One solution could be having several journal clubs run in parallel with the same papers being discussed in each class room. This might not be a major problem, but it is important that the discussions will contain the same degree of information in each class room as the discussed papers will be part of the final assessment of the students. This solution will require more teachers (the program for the students makes it impossible for them to have lessons at different time points), and will thus require a high degree of coordination between the teachers such that the scientific content is comparable between each class room.

In this project I would like to investigate how the journal club situation can be optimized for a higher number of students and still result in the same learning outcome. How can you change the teaching style? What type of teaching activities could be included? As already stated there are currently 39 students in the class, which I personally find too many for in-plenum discussion. Therefore, I would like to find out what the students think about the current situation.

Data collection – Student survey

In this project I have used a focus-group interview. The focus group consisted of seven students' three girls and four boys from this year's Experimental Molecular Biology course. The students freely volunteered for the interview in which I did not participate myself. In fact the students were unaware that a teacher from the course was involved in the investigation. I will also include the comments related to the journal club part of the course from the final student evaluation for the course. Finally, a few comments from the student evaluation from a different course "Frontiers in Plant Science" will be used. The reason for this is that this course is a journal club course in which I also taught. In both courses I tried to implement group work in two different ways to see if this could improve the teaching situation.

Results – Student survey

Both from the interview and the two student evaluations it is clear that the students find it very important to have journal clubs for them to be able to learn how to read scientific papers.

> *Focus-Group Citation 1 (FGC1): "Kan godt lide journal clubs...det jeg næsten får mest ud af" "Det der med at læse artikler.. kan jeg ikke finde ud af."*
> *FGC2: "Får meget ud af at arbejde med journals… det er rigtigt godt"*
> *Evaluation comment 1 (EC1): "The journal clubs are amazing!"*

Furthermore, the students think it is very important to have allocated time to discuss science and to relate to their own findings in the laboratory exercises.

> *EC1: "Journal clubs var helt fantastiske. Dejligt endelig at få lov til at diskutere artikler."*
> *EC2: "The discussion in the journal Clubs provided new insights and the questions asking for something that I probably wouldn't have thought about otherwise."*
> *EC3: "JC, hvor man får lov til at analysere og kritisere de anvendte molekylær biologiske teknikker og reletere til vores exercise."*
> *EC4: "JC worked really well when the articles complimented the topic or method we were working on in the lab."*

What do the students think about the way the journal club currently is processed?

When asking the students what they think about the current format of the journal club session the answers can be split into two groups. Some students find the format as it is now good and inspiring and that the responsibility for gain of knowledge is up to the individual student.

> *FGC1: "Synes det er ok… forventning om, at når jeg går der fra forstår mere men ikke alt"*
> *FGC2: "Hvis man ikke får noget ud af det må man kigge ind af, man kan altid spørge undervejs"*
> *EC1: "Journal club presentation is a good way of working with the articles even though you get more out of you own journal presentation."*

On the other hand it became clear from the focus-group interview that a large segment of the students does not agree in this. The general trend among this group of students is that the student activation in the current journal club situation is too limited. They also find it problematic that not all students are equally prepared for the journal club session. And that it is a problem that they do not feel prepared to be able to ask relevant questions.

FGC1: "*Fungerer ikke at der er en enkelt gruppe der skal sætte sig helt vildt godt ind i det og en opponent gruppe der skal sætte sig forholdsvist godt ind i det og de andre godt men ikke lige så godt grænse for hvor godt. Dem der fremlægger, forstår først det hele efter at have snakket med den ansvarlige og den forståelse mangler ALLE Jo!....*" "*Dem der stiller spørgsmål har ikke grundlaget for det.*"

FGC2: "*...det er lidt diffust når man ikke selv har siddet og arbejdet med det og selv diskuteret*"

A few comments were also directed towards the practical settings of the journal club for instance it was pointed out that the room wherein the journal club is held could be more optimal. Currently the journal club is held in an auditorium, which means that all students are facing in one direction except the group presenting the paper. And that, due to the fact that the journal club session is guided by 10 different teachers, it is important with a general structure of the sessions, which all teachers follow.

FGC1: "*Som det er nu er det ikke en klub, ikke jc nogle fremlægger og er på:.*" "*tænk på hvordan vi sidder... alle sidder og kigger ned på dem (dem der præsentere)*"

EC1: "*Make sure all the teachers know what to do in the journal clubs - it was confusing that it was different every week.*"

What should be changed in the current format and why?

The overall trend in the suggested changes is that the in-plenum discussion does not work out due to the number of students, it is simply too large a crowd. It is also clear that the students want to be actively involved in the discussion and that they find it difficult in the current situation. They also point to the fact that they do not spend the same time preparing for the class if they are not involved in the presentation or opponent group. They suggest that the students should be encouraged to prepare in teams before each session. They indicate that they know that it would be beneficial to prepare better, but it seems that the preparation might have to be structured for them to actually manage to do so.

FGC1: "*smartere hvis man teamede to journal grupper sammen, også skiftes til at fremlægge... meget federe" "Større arbejdsbyrde men mindre forum meget mere øvelse i at fremlægge og at være kritisk osv.*"

FGC2: "*...hellere færre journal clubs og mere intensitet og større aktivitet per person ikke bare sidde passiv, det kommer man meget nemt til hvis man ikke har læst den der journal godt nok til at kunne stille spørgsmål*"

FGC3: "*...tænker alternativet kunne jo være at man rent faktisk bruger jc noget mere så jc kender hinanden så godt så de egentligt kan sidde lidt med artiklerne og diskutere dem før en anden gruppe fremlægger ... jeg fik jo super meget ud af at diskutere hvad det egentligt var jeg læste før vi skulle fremlægge*"

FGC4: "*...så er det jo netop godt at sidde og diskutere... jeg ville personligt få mere ud af det i et mindre forum*"

FGC5: "*hvis der var lagt op til at man i de forskellige jc lige sad og snakkede om hvad man egentligt lige havde læst og hvis der var noget man ikke forstår så man kommer til i bunds med den, så ville man inde til forelæsningen faktisk kunne stille relevante spørgsmål*"

Towards a solution: Group work

In the two journal club sessions in which I was the responsible teacher I decided to implement group work covering specific parts of the presented papers. In both situations there was still a student presentation followed by a short in-plenum discussion before I introduced the group work.

In the course "Experimental Molecular Biology" I had made four questions covering different parts of the paper. The students were split into 8 groups (each containing one member from either the group presenting the paper or the opponent group). Group 1 and 2 was asked to start with question 1, group 3 and 4 question 2 and so forth (all groups should look at all questions but in different order). After the group work we had an in-plenum sum-up where the two groups starting with the specific question was given the opportunity to answer first. This way I was sure that all groups were actively participating in the discussion and that all four questions would be covered.

In the other course "Frontiers in Plant Science" (15 students) I focused the group work around the methods used in the paper (as I had seen the power point presentation from the student, I knew this part was not being presented in detail). The students were split into 4 groups and each group was responsible for a specific method in relation to a given figure from the paper. Instead of specific questions, the students were given a figure from the paper. They should be able to explain how the figure was generated, suggest other methods that could have been used instead and in which other cases this specific method could be used. After end group work each group came to the black board and presented/discussed their findings by the aid of power point slides that I had prepared for them to use if they wanted.

What do the students think about this teaching activity? - In comparison to the traditional journal club style with in-plenum discussion
In general I would say that there was a very positive atmosphere at the two sessions this is in accordance with the conclusion Prince (2004) came up with. Prince concluded that the time spend in groups has a positive effect on student attitude and that collaborative work furthermore enhances student retention and the general academic achievement.

As the focus-group interview was held before my actual teaching I can only use the comments from the evaluation form from the two courses. From these comments I can conclude that the students do like to work in groups and that they find it relevant in combination with the journal club.

EC1: "*JC artikler kunne man have færre af, men give mulighed for at flere grupper arbejder med dem i grupper.*"
EC2: "*Include some theoretical exercises as part of JC or in the breaks in the lab (example: like theoretical exercises Lisbeth made after the JC during exercise G (yeast)).*"
EC3: "*Journal Clubs følte jeg var lidt for lange i det. Her ville jeg hellere have haft en time med journal præsentation, spørgsmål til artiklen og feedback end at det skal tage to timer det hele. Den sidste time kunne blive brugt til at lave teoretiske øvelser som derefter skulle gennemgås i plenum. De teoretiske øvelser skulle afspejle opgaver der kunne komme til eksamen, således at man er bedre klædt på til eksamen." Evaluation result Trends in Plant Science:* "
EC4: "*Formen af undervisning har været rigtig god, det har fungeret med en intro til emnet herefter en præsentation (JC) og*

> *så at man selv skulle arbejde med dele af artiklen i de små grupper!!*"

Alternative teaching activities, which advantageously could be implemented

In this project I have only tested if the use of group work during a classical journal club session could increase student activation and promote a positive teaching environment. But several other teaching styles could be used while still supporting the intended learning outcome. What I have learned from the student survey is that (I) student activation during the session and (II) student preparation for the class is very important for the success of a journal club session. These two key issues are also in the literature stated as important factors for an effective journal club situation (Lee et al. 2005, Deenadayalan et al. 2008). I have therefore looked into what type of activities that could promote these two things.

How can student activation and preparation be improved?
One way to change the activities in-class could be to use a teaching style called "POGIL" an abbreviation for "Process Oriented Guided Inquiry Learning". This is a student-centered teaching style where the students work in groups on material facilitated by the teacher (Murray 2013). It is a method in which the students in addition to content learning will be trained in process skills, and ability to invent and apply concepts. In relation to reading primary literature this activity can be integrated in a way where the students will be given for example figures, tables, part of the method section etc. from the paper and asked to explore the information, develop the concept related to a model and apply it in a new situation. The activity can also be used in the preparation time prior to the journal club where the students can be asked to study the general topic, content area and methods.

It is my feeling that the students would like to spend time prior to the journal club session to be prepared for the class but that it might be difficult for them to know exactly how to do this in the most beneficial way. One way to guide the students in this process could be to introduce the use of dialectical notes (McDonough 2012). The use of dialectical notes can also improve the participation in the discussion during the journal club session. It is a technique, which will help the students to pick out the important parts of a paper and in addition also help them to acknowledge what statements in the paper they do not fully grasp (yet). The use of dialectical notes will increase the active reading by the students and help them to structure their preparation time for each session.

Iyengar et al. (2008) introduced a completely different setup for journal clubs. Instead of having a presentation followed by an in-plenum discussion, the students were asked to answer several question related to the paper before the in-class session. At the journal club the students were individually being asked to explain figures and tables. This part was followed by a discussion covering the paper and the beforehand posted questions. This method will help the students in the preparation and since the students do not know who is going to explain the figures all students will prepare equally well for each session and not only for the session in which they are "responsible". This method will also activate many students during the class.

Deenadayalan et al. (2008) have through a systematic review of different ways of running an effective journal club come to several conclusions. Based on these conclusions they among other things recommend that prior to the in-class situation several broad questions related to the specific paper should be raised. These questions could guide/support the students during the preparation time and help them focusing on the important parts of the paper.

The learning outcome will if at all, be affected positively by the suggested changes

It has been shown that the use of the POGIL method will increase student abilities and comfort level working with primary literature. This is of great importance for bachelor students (Murray 2013). I think it will improve the learning outcome to work in groups on defined parts of the paper supervised by the teacher compared to having a general discussion without a specific focus. Especially for bachelor students it is important to structure the teaching activities such that they will learn to focus on the important parts of a paper.

Using active reading and writing dialectical notes formulating questions before the class will guide the students to clearly identify what they do understand what they do not understand yet. The formulation of question in relation to what they do not understand might as well help the students overcome the fear of asking questions in a larger crowd. This I am sure will positively affect the learning outcome in the journal club session. I could also see this method used as a group preparation if students prefer to prepare in small groups, where they before class can discuss their observations and find out if there is overlap between what they do not understand yet. They can help each other to come to a general understanding and if there is something none of them understand this part can be brought up during the journal club. This will also help the teacher to asses if the intended learning outcome has been reached. The same is the case if one chooses to raise broad/open questions related to the specific paper, which should support the intended learning outcome. The questions could help both the students and the teacher to be prepared for the in-class session.

Conclusion and reflection

It has been interesting to learn what type of teaching activities the students prefer. It is not surprising to me that they prefer to be involved actively compared to passively listening, but it actually also seems as if they would not mind to spend more time on the preparation for the class. They suggest that they could prepare in groups and make pre-discussions before the actual lesson. I think that might be a very good idea however it might be impossible for some students due to private activities therefore I think the introduction of dialectical notes or broad questions linked to the paper could be an alternative to this suggestion.

I am definitely going to use group work in my future journal club sessions. The students argue that it led to frustration and misunderstandings that the journal clubs were not executed the same way each week. One solution to this problem could be that we in the teaching group agree on a more general way to carry out the sessions or at least spend time to explain the students that the journal club sessions can and will be executed in many ways but that they all still support the intended learning outcome.

Personally I think it is important to link the preparation time and the actual journal club situation as I think more students will be activated during class if they feel well prepared which will make them more self-confident in the in-class situation. Structuring the preparation time for the students, and linking it to the actual journal club situation would also be very beneficial if the solution is to run several journal clubs in parallel. It will be very helpful in the coordination between the teachers and will support the fact that the scientific content will be similar in each class room.

Part IV

Supervision and supervision styles

20

How to improve your supervisory skills

Jacob Andersen

Department of Drug Design and Pharmacology, Faculty of Health and Medical Sciences, University of Copenhagen

Introduction

The supervisor-student relationship has been described as “the most important channel of intellectual inheritance between one generation and the next” (Gurr 2001), and “supervision” has even been described as “the most important variable in a successful research process” (Dysthe & Samara 2006). Hence, it is widely acknowledged that supervision is an important factor within research processes. However, a supervisor at the university typically qualifies for the job on the basis of his or her achievements as a researcher, and the quality of supervision at the universities is thus largely determined by the accidental occurrence of natural supervisory skills (de Graff et al. 2011). Furthermore, several studies have revealed the vulnerability of the individualized supervisor-student relationship, including overdependence on the supervisor, lack of ownership and mismatch of personalities, and a major challenge in the supervisor/student relationship is the difficult balance between authority and independence (Dysthe & Samara 2006). Unfortunately, it has proven to be rather difficult to find evidence-based studies related to supervisory styles and changes of style over the supervisory period (Gatfield 2005). There can be huge variations in the scientific level, ambitions, personality and cultural background between students, and one of the important challenges for supervisors is therefore to adapt the supervision to each student and find an appropriate balance between support and control (Wichmann-Hansen et al. 2013) Due to this idiosyncratic nature of supervision, it is difficult to setup strict rules and guidelines for “good supervision” at the universities. In this report, different supervisory "tools" that can facilitate open discussions between student and supervisor on the supervisory style and their supervisory relationship are presented. These tools can hopefully serve as operational guidelines for alignment of the students and supervisors expectations to the supervisory process and adjustment of the supervisory style during the supervisory period, and thus aid in improving supervision of students at the university. It is important to note, that if the supervisory period is restricted to a limited time period (< 6 months), it may seem irrelevant to spend too much time and effort on improving the supervision. The tools described herein are thus mostly relevant for supervision of 1-year master's thesis students and PhD students.

Establishing a good relationship between student and supervisor

Several studies have found that dissatisfied students often have problems with their relationship to their supervisor (Gurr 2001). Hence, a good supervisory relationship seems to be important for keeping students satisfied and motivated. Accordingly, Wichmann-Hansen et al. (2007) found that successful supervision is highly dependent on establishment of a good and reliable relation between the student and the supervisor in the beginning of the progress. Unfortunately, meetings between supervisor and student are typically dominated by discussing the technical and theoretical aspects of the research project, and "soft issues" such as supervisory relationship are avoided. Due to the natural authority of the supervisor, it can be difficult for many students to introduce such subjects. Instead, the students can feel more comfortable discussing the supervisory relationship when the process is initiated by the supervisor. However, it can also be difficult for the supervisor to initiate the process in a purely face-to-face discussion. In the following, some supervisory tools that can be used to dilute the potential awkwardness in these discussions are being presented:

Written understandings and supervision contracts
The supervisor and the student have their own expectations and conceptions of "supervision". If these expectations are not aligned from the beginning of the project, it can lead to frustrations, irritations and disharmony which eventually will develop into a far from optimal supervisory process. An efficient way of aligning expectations is through explicit and written informa-

tion such as a *written understanding* from the supervisor or a *supervision contract* between the student and the supervisor (Rienecker et al. 2005). In the written understanding, the supervisor can explicitly describe his or her supervisory style and expectations to the supervision process (see Rienecker et al. (2005) or Wichmann-Hansen et al. (2013) for examples of a written understanding). The written understanding is given to the student at the beginning of the project and gives a clear impression of the supervisor's approach and expectations to the process. The written understanding should not represent a definite offer for what the student can expect from the supervisor. Rather, it should serve as a starting point for discussions between the student and the supervisor about the supervisory style. This can then lead to the composition of a supervision contract, which is a mutual written agreement between the student and the supervisor concerning the supervisory process, and can include issues such as level of independency, feedback on written material, frequency of project meetings or other issues that the supervisor or student find important (Wichmann-Hansen et al. 2013). Some supervisors may find that written understandings and contracts are too formalized and time-consuming, but the approach offers an opportunity for the supervisor to explicitly align his or her expectations with the expectations of the student.

Supervision expectation questionnaire

A simpler model for alignment of expectations, which may be more readily accessible for busy supervisors and students, is a *supervision expectation questionnaire*. A supervision expectation questionnaire contains a list of key statements and/or questions concerning different aspects of supervision (Figure 20.1).

Read each pair of statements below and then estimate your position on each. For example, if you strongly believe that it is the supervisor's responsibility to insist on regular meetings, put a ring around "1" in the first statement. If you think it is definitely the student's responsibility, put a ring around "5".		
The supervisor should insist on regular meetings with the student	1 2 3 4 5	*The student should decide when she/he wants to meet with the supervisor*
The supervisor should take over final writing-up of the thesis if the student is having difficulty	1 2 3 4 5	*The writing of the thesis should only ever be the student's own work*
A warm, friendly relationship between supervisor and student is critical for successful candidature	1 2 3 4 5	*A warm, friendly relationship is inadvisable because it may obstruct objectivity for both student and supervisor during candidature*

Fig. 20.1. Examples of statements/questions that can be used in a supervision expectation questionnnaire. Adapted from http://researchsuper.cedam.anu.edu.au/stages-candidature/clarifying-expectations (August 2013).

First, the student and supervisor must individually decide on their own responsibility of the listed statements in the questionnaire, which is followed by a comparison and discussion of their answers. In this way, the expectations are being explicitly discussed and aligned between the student and the supervisor. The statements in the questionnaire are defined by the supervisor and can include different subjects such as level of ambition, responsibility of the student, frequency of project meetings, scientific support, personal relations between supervisor and student etc. The supervisor can therefore use the questionnaire as a route to put emphasis on specific themes that he or she find important (Wichmann-Hansen et al. 2013).

Adjusting the supervisory style over the course of candidature

The successful student will typically develop from a state of relative dependency to competent autonomy over the period of candidature. Progress along this continuum should not be seen as consistent in either pace or direction. Periods of slow progress and of elevated levels of dependency are likely when new phases (such as data analysis or thesis writing) are initiated. Thus, there is a continuous need throughout the supervision period for the supervisor to find a balance between giving adequate, timely help and not interfering. Unfortunately, some supervisors may adopt a static supervisory approach, or, if it is altered, this may not be done in alignment with the growth and emerging needs of the student but on the basis of an "I know what is best for the student" attitude, which can be hard for the student to challenge. Two supervisory tools that can be used for appropriate adjustment of the supervisory style over the course of candidature is presented in the following:

The supervisor/student alignment model

The supervisor/student alignment model can be used as a tool to facilitate discussions between supervisor and student to allow the student to develop competent autonomy over the course of candidature (Gurr 2001). The supervisor/student alignment model can be visualized as a two dimensional graph with the supervisory approach on the X-axis and the student development on the Y-axis (Figure20.2).

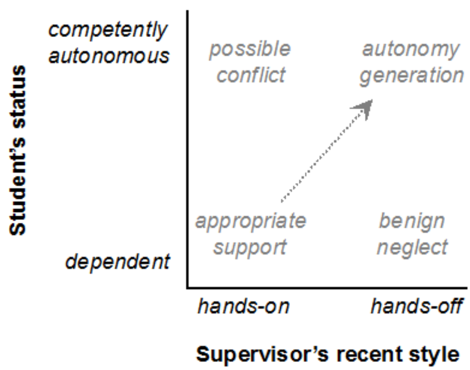


Fig. 20.2. Two dimensional representation of the supervisor/student alignment model showing outcomes for four combinations of student's state and supervisor's approach, and a hypothetical line showing the desired academic growth over the course of candidature. Adapted from Gurr, 2001.

In practical terms, the supervisor and the student must first individually place an "x" on the figure representing their perception of the current state of the relationship. This simple action is underpinned by careful reflection on both their own and the other party's status on the appropriate axes. Hereafter, the supervisor's and the student's respective views of the relationship must be discussed at a dedicated supervisory meeting. If there are discrepancies between the views of the supervisor and the student, this can lead into discussions to explore the basis for differences. This exercise can be repeated with appropriate intervals (dependent on the length of the project period; e.g. every 3 or 6 months), and the model can thus not only be used to align the expectation to the supervisory style but also be used to evaluate the academic growth of the student throughout the project. Students who have been exposed to this model generally find it useful and a beneficial facet of their supervision. Furthermore, the model initiated reflections about their academic growth and thus aided in pushing them towards competent autonomy during the supervisory period (Gurr 2001)

Supervisory management grid

The *supervisory management grid* describes four different supervisory styles which is dependent on the role of the both the student and the supervisor (Figure20.3) (Gatfield 2005). As for the supervisor/student alignment model, the supervisory management grid can be used with appropriate intervals to facilitate discussions between supervisor and student about the types of supervision styles and the timing of their application, and thus be used as a tool to adjust the supervisory style over the course of the candidature.

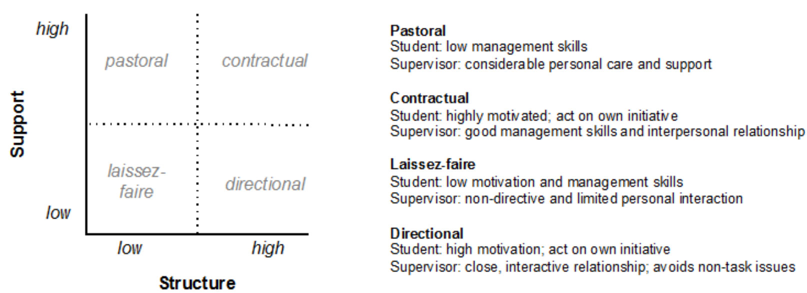


Fig. 20.3. Two dimensional representation of the supervisory management grid, showing the four different supervisory styles. Key words describing characteristics for the different supervisory styles are also shown. Adapted from Gatfield, 2005.

Partnership between student and supervisor

According to Dysthe & Samara (2006), the relationship between supervisor and student can be perceived in three different ways: *the teaching model, the apprentice model* and *the partnership model*. The teaching model is the traditional teacher-student relationship, where the teacher is the expert and the student is highly dependent on instructions from the teacher. In the apprentice model, the student is initially observing how to perform specific tasks and solve different issues, before he or she is allowed to work independently; initially with simple tasks and gradually with more and more demanding task as the student gets more experienced. As the name implies, there is a more symmetrical relationship in the partnership model, in which the student has a more responsible and active role. In this model, the supervisor and student explore different options and solutions together, and the student is encouraged to critically evaluate and reflect on the decisions and conclusions made during the process.

Due to experiences from their own schooling, many supervisors will have a tendency to act as "teachers", and especially within natural sciences the relationship between student and supervisor can often be described according to the apprentice model (Wichmann-Hansen et al. 2013). However, it is recommended to aim for a partnership between supervisor and student (Dysthe & Samara 2006, Wichmann-Hansen et al. 2013). This will encourage students to take responsibility for their own teaching and allow them to actively contribute to problem definition and project design, which will strengthen the student's independency, responsibility, ownership, and motivation (Krogh et al. 2013). The partnership model is a rather ambitious model that is highly dependent on the willingness and ability of the student to meet the required responsibilities. It is therefore important that the supervisor defines the respective roles of the two parties in the intended partnership and invites the student to take an active role from the beginning of the supervisory process. It is critical that the supervisor allows a certain degree of "student voice and choice" and avoids the "I know what is best for the student" attitude. Also, since the model is based on dialogue, the supervisor must master different questioning techniques (e.g. use open-ended questions to facilitate high quality teaching (Biggs 2003)) and use meta-communication (i.e. to communicate about your communication) to avoid misunderstandings and to increase the output of the supervision (Krogh et al. 2013). Thus, the partnership model is challenging but when it is successfully applied it can facilitate active participation of the students and improve their independency, responsibility, critical thinking and reflections compared to the teaching and apprentice models.

Summary

To improve the chances of success in a supervisory process it is important that: i) the supervisor and student's expectations are aligned from the beginning of the project, and ii) the supervisory style is adjusted over the course of candidature. This can be achieved through open discussions and mutual written agreements between the supervisor and student (Figure20.4). Furthermore, a responsible partnership with the student can help strengthen his or her independency, responsibility, critical thinking and ownership of the project.

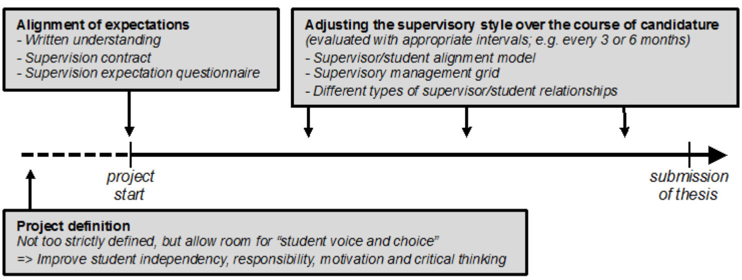


Fig. 20.4. Overview of the herein presented supervisory tools that can be applied to improve the supervisory process.

Part V

Peer teaching and Peer assessment

21

Anvendelse af peer-feedback i kurset "Idræt, Individ og Samfund"

Charlotte Østergaard og Glen Nielsen

Institut for Idræt og Ernæring, Københavns Universitet

Baggrund: Beskrivelse af kurset "Idræt, Individ og Samfund"

Kurset "Idræt, individ og samfund" er et obligatorisk fag på den Humanistisk-Samfundsvidenskabelige kandidatuddannelse i idrætsvidenskab. Formålet med kurset er at give de studerende en introduktion til sociologiske, pædagogiske og psykologiske teorier, som anvendes under deres kandidatkurser.

Kursets overordnede læringsmål er følgende:

- De studerende skal have grundlæggende viden om faglige teorier, der belyser samspil mellem individ og samfund, og hvordan teorierne anvendes i relation til idræt og kropskultur.
- De studerende skal kunne sammenligne de forskellige teoriretninger og kunne belyse teoriernes svagheder og styrker, samt opnå færdigheder i at analysere og reflektere over teoriernes relevans med henblik på at kunne forstå idræt som genstandsfelt.
- De studerende skal kunne beskrive, analysere og vurdere aktuelle samfundsmæssige problemstillinger og cases. De studerende skal udvikle en forståelse for teoriernes betydning for deres fremtidige rolle som fx underviser, konsulent eller forsker.

Kurset varetages af undervisere fra de to humanistisk- samfundsvidenskabelige forskningsgrupper "Krop, læring og identitet" og "idræt, politik og velfærd" og indeholder tre udvalgte psykologiske og pædagogiske teorier/ tilgange samt fire udvalgte sociologiske og kulturteoretiske tilgange.

Undervisningen er obligatorisk, og eksamensformen er en skriftlig 48 timers hjemmeopgave på maksimum 10 sider baseret på pensum med centralt stillede spørgsmål.

Kurset blev oprettet i 2011, og vi har begge undervist på kurset siden opstart i to af de fire sociologiske tilgange, Glen i Anthony Giddens og Charlotte i Pierre Bourdieu.

Undervisningsformen som den er beskrevet i lektionsplanen

- Mandag er hovedsagelig forelæsningsdag.
- Tirsdag er der forelæsning og gruppearbejde.
- Fredag er øvelsesdag, hvor de studerende i grupper analyserer en case med anvendelse af de i løbet af ugen gennemgåede teorier på empiri. Øvelserne afleveres som en synopsis til bedømmelse om fredagen.

Analyse af mulige forbedringer af kurset

Under fokusgruppeinterview med kandidatstuderende på den humanistiske-samfundsvidenskabelig kandidatuddannelse, der alle havde gennemført kurset "idræt, individ og samfund", viste det sig, at de studerende savnede indsigt i sammenhængen mellem de forskellige teoretikere, der undervises i på kurset[1]. Dette er ellers formuleret som et officielt læringsmål for kurset:

> "De studerende skal kunne sammenligne de forskellige teoriretninger og kunne belyse teoriernes svagheder og styrker, samt opnå færdigheder i at analysere og reflektere over teoriernes relevans med henblik på at kunne forstå idræt som genstandsfelt."

De studerende oplevede det som problematisk, at forskellige undervisere præsenterer og formidler de forskellige teorier uden at formidle, hvordan de relaterer sig til hinanden, mens de til eksamen netop skal analysere dette. Vi havde inden fokusgruppe interviewet fandt sted diskuteret netop denne udfordring ved kurset, da vi ud fra et fagligt synspunkt mener, at det er problematisk ikke at have læringsaktiviteter, der behandler sammenhængen og

[1] Dette fokusgruppe interview blev udført i forbindelse med vores pre-projekt under KNUD.

relationerne mellem de forskellige teorier, da disse kun kan forstås i relation til hinanden, fordi de i høj grad er forskellige bud på svar på de samme spørgsmål, og fordi disse teorier er udviklet i en kritisk dialog (Layder 1994).

Vi ønsker derfor med dette projekt at undersøge, hvordan vi giver de studerende på kurset "Idræt, individ og samfund" en bedre forståelse af relationen mellem de forskellige teorier som er indeholdt i kurset.

En anden udfordring på kurset er, at det består af forelæsninger og gruppeopgaver, som de studerende får feedback på af underviseren. At give brugbar feedback på de mange opgaver er en stor arbejdsopgave for underviserne. Yderligere synes det primært summativt og ikke særligt formativt at give feedback efter endt undervisningsforløb, mens de studerende er i gang med at blive undervist i en ny teoretiker. Studerende har tidligere og igen i år beskrevet dette overlap som forstyrrende og problematisk og man kan tvivle på, hvor meget de studerende får ud af denne skriftlige feedback, hvor de ikke har nogen mulighed for at stille spørgsmål til feedbacken, og hvor vi som undervisere ikke ved, om de har forstået, det vi skriver til dem. Endelig er der efterhånden en del studier der peger på, at peer-feedback producerer endnu mere læring end blot feedback fra underviseren alene. For et review se Biggs & Tang (2011).

Vi ønsker derfor at afprøve en anden form for feedback på dette års kursus. Flere undersøgelser har vist, at evaluering og konstruktiv feedback har større betydning for de studerendes læring end selve undervisningen, og studier peger yderligere på, at peer-feedback producerer endnu mere læring end blot feedback fra underviseren alene, særligt hvis denne organiseres i grupper (Cho & MacArthur 2010, 2011).

Derfor ønsker vi i dette KNUD-projekt at afprøve og undersøge, hvordan gruppeopgaver som evalueres via peer-feedback i grupper kan anvendes til at arbejde med og skabe indsigt i, hvordan de forskellige teorier indeholdt i kurset relaterer til hinanden.

Problemformuleringen er således: Hvordan skabes bedre forståelse for og indsigt i relationen mellem forskellige teorier indeholdt i kurset idræt, individ og samfund gennem brug af gruppeopgaver med peer-feedback.

Brug af Peer feedback som undervisningsmetode

Vores undervisning i hhv. Pierre Bourdieus og Anthony Giddens sociologiske teorier på modulet idræt, individ og samfund blev dette år tilrettelagt således, at de studerendes gruppeopgaver blev evalueret via mundtlig peer-feedback fra en af de andre grupper på den sidste undervisningsgang. Feedbackprocessen foregik i selve undervisningen, således at der også er en underviser til stede, som kunne støtte op om feedbackprocessen. Vi underviste en uge hver i en sociologisk teori. Mandag var forelæsning, tirsdag fik de gruppeopgaven og fredag morgen fik grupperne de slides med noter fra den gruppe de skulle give peerfeedback til (mens de selv skulle aflevere deres slides til den gruppe som skulle give dem feedback).

Nedenstående skema viser, hvordan vi har valgt at strukturere de tre undervisningsforløb, som fandt sted for hver teoretiker (Fig. 21.1).

Mandag kl.8-10	Tirsdag kl. 15-17	Fredag kl. 9-12
Forelæsning	Gruppearbejde i de 6 grupper	Studenterpræsentation, Peer-feedback og diskussion

Figur 21.1. Struktur for undervisningsforløb for hver teoretiker.

I bilag A og B, ses gruppeopgaverne for arbejdet med hhv. Bourdieus og Giddens sociologi. Bilag C viser oplægget til peer-feedback arbejdet de studerende skulle udføre. Bilag D viser en oversigt over fredagens forløb.

Feedbackprocessen om fredagen fungerede således, at der blev afsat en time til at gennemse og finde frem til spørgsmål til oplægget som grupperne skulle give feedback på (se bilag C for rammesætningen). Dernæst blev holdet bestående af seks grupper delt i to. I disse to hold skiftes grupperne til at fremlægge deres gruppeopgave, som de så fik feedback på fra deres feedback gruppe, mens den tredje gruppe observerede og afsluttende også havde muligheder for at give deres kommentarer til hele processen.

De andre år har vi savnet at kunne gå i dialog med de studerende omkring deres produkter, og at der i højere grad er en vidensdeling og diskussion på holdet. Derfor har vi valgt, at de skal præsentere mundtlig, og ikke kun for os, men også for deres medstuderende, og at alle studerende skal arbejde med at give feedback. Ved at lade de studerende give feedback til hinandens produkter er det vores håb, at de gennem den refleksionsproces, der opstår ved at give konstruktiv feedback, vil tilegne sig stoffet på en ny og anden måde, som skaber øget mulighed for dybdelæring. Denne form for øget refleksion over og anvendelse af pensum håber vi ligeledes er til stede i den diskussion der opstår efterfølgende.

Fokus på sammenhænge og overgangen fra en teori til den næste

Opgaverne blev konstrueret sådan, at der i ugen efter undervisningen i Bourdieu, hvor Glen underviser i Giddens, blev stillet spørgsmål til forskelle og lighed mellem de to teoretikere. Med denne metode var vores intention at bidrage til øget indsigt i hvordan de to teorier relaterer til hinanden.

Vi har følgende mål med undervisningen:

1. Undervise på en måde som i højere grad involverer de studerende.
2. Undervise på en måde så de studerende i højere grad opnår indsigt i forholdet mellem teorierne

Evaluering af hvorvidt de beskrevne undervisningsaktiviteter tjente de ovenfor beskrevne formål samt analyse af mulige forbedringer af undervisningsforløbet

Vi havde på forhånd gjort de studerende opmærksom på, at vi som led i vores adjunktpædagogikum ønskede at strukturere undervisningen på en anderledes måde og fortalt om hovedtrækkene i forløbet, samt at vi ønskede at modtage deres feedback. De to former for studenterfeedback er baseret på mundtlig feedback på undervisningen som afslutning af forløbet i begge uger samt de studerendes evaluering af kurset på Absalon. Derudover bygger evalueringen af forløbet på vores egen oplevelse af forløbet samt på kollegafeedback. To kollegaer, som også underviser på kurset, observerede undervisningen. Vores faglige supervisor deltog begge fredage og modulansvarlig deltog den sidste fredag.

De studerendes oplevelser af undervisningsforløbet med Peer feedback

Den mundtlige tilbagemelding vi fik som afslutning på de to undervisningsforløb af de studerendes oplevelse af gruppearbejdet og peer feedback processen var opvejende positiv, uddybet og sammenfattet i nedenstående beskrivelse:

De studerende oplevede, at det virkede godt med triadegrupperne, hvor man hele tiden har en rolle. Det gør at man ikke keder sig, og så var det spændende at få lov til at afprøve flere roller; formidler ved oplæg, spørgsmålsstiller og observatør. De nævnte, at metoden gjorde at de fik en bedre dialog, og at de gerne ville have endnu mere tid til dialog, tiden var fløjet af sted, en studerende sagde, at han synes det var så relevant at han gerne ville have blevet tre timer mere. Nogle af de studerende oplevede det som frustrerende, at man ikke kunne svare igen på observatørgruppens kommentarer. Det blev bemærket, at emnerne for oplæggene (de spørgsmål som besvares i gruppeopgaverne) ligger tæt op ad hinanden, men de studerende oplevede det som givende, at man hørte om det flere gange, idet det gav nye perspektiver og nye måder at tale om problemstillingerne, som de ikke selv havde tænkt over. Flere lagde vægt på, at det var dejligt at komme mere i dybden både med de konkrete problemstillinger, men også at selve formen betød, at de var kommet mere i dybden med Bourdieus og Giddens teorier end de havde gjorde ugen før, hvor emnet var Eliass' teori. De studerende var enige om, at det var rigtig godt at arbejde med cases, men at det var vigtigt at opgaverne var teorinære. Desuden blev det fremhævet, at arbejdsmetoden med både Power Point fremlæggelse og feedback var tæt på den arbejdsmæssige praksis mange af dem ender i efter endt uddannelse, hvorfor de også synes det var godt at blive tvunget til at lave noter til Power Point slides.

De studerendes evaluering af kurset på kursushjemmesiden på Absalon sker via et spørgeskema, som ikke spørger specifikt til vores forløb med peer feedback. Yderligere har ganske få (7 af 45) besvaret spørgeskemaet. Dog har et par stykker af disse i deres endelige kommentar givet en relevant kvalitativ information om effekten af at arbejde med peer feedback i grupper i stedet for at aflevere en skriftlig gruppeopgave, som der gives skriftlig feedback på af underviseren (som det gøres i de øvrige teoriforløb på kurset).

> "Ift. gruppetimer så lærte jeg meget mere af at diskutere og fremlægge i grupper, modsat da vi skulle skrive en fem sides opgave på tre timer. Da bliver opgaverne fordelt, og det handler om at få opgaven skrevet så hurtig som muligt, i stedet for at have tid til at sætte sig ind i stoffet."

> "Flere mundtlige fremlæggelser undervejs i stedet for skriftlige opgaver."

Opsummerende viser evalueringen, at de studerende oplevede forløbet som både motiverende og relevant. De studerende oplevede, at de mundtlige fremlæggelser og arbejdet i triadegrupperne gav et højere læringsudbytte end de skriftlige opgaver.

Vores samt kollegaers oplevelser af undervisningsforløbet

Arbejdsintensiteten var høj. Det var overraskende hvor gode de studerende var til at besvare gruppeopgaverne og lave fremlæggelser med gode anvendelser af teorierne, som alle kunne lære noget af. Vi havde ikke forventet, at de kunne opnå så omfattende og korrekt indsigt i, forståelse af og analyse med teorierne på så kort tid og på baggrund af kun 2 * 45 minutters forelæsning. Der er blevet arbejdet godt med pensum litteraturen. Når feedback grupperne gav deres feedback blev der skabt en god dialog og diskussion, som skabte nye pointer og indsigter. Flere studerende inddrog relevante eksempler/erfaringer fra deres studenterjobs som kvalificerede diskussionerne og som eksemplificerede og udfordrede teorierne.

Mulige forbedringer

Vi ønskede med feedbackprocessen at åbne for refleksion og dialog. For at få de studerende til at have en nysgerrig og ikke dømmende tilgang til hinandens fremlæggelser konstruerede vi et arbejdspapir (se bilag C). På trods af at vi i oplægget til peer-feedbackøvelsen lagde vægt på, at processen skulle være dialogbaseret kom nogle feedback grupper alligevel til at have en bedømmende tilgang og dermed basere deres feedback for meget på ris og ros. En mulig forbedring fremover kunne derfor være at vi mundtligt gennemgik feedbackmetoder i undervisningen[2]. I en enkelt gruppe var der en meget ulige fordeling af opgaverne med at fremlægge og give feedback på den vis, at to af deltagerne tog det meste af taletiden. Dette kan undgås ved at lave klare rammer for en rollefordeling i grupperne, så alle får en rolle i enten fremlæggelse, feedback eller observation.

[2] I vores planlægning af undervisningsforløbet havde vi overvejet at inddrage undervisning i feedbackmetoder som støttende forberedelse til arbejdet i triadegrupperne. Vi valgte dog at undlade det, efter at vi havde konstrueret arbejdspapiret til arbejdet i refleksgrupper (bilag C), da vi synes det gav de studerende en fyldestgørende retning for feedbacken. Efterfølgende har vi reflekteret over det forhold, at de studerende på idrætsuddannelsen bliver præsenteret for en fejlretningsfeedback i de praktiske fag, hvilket sandsynligvis har haft en afsmittende effekt. Af den årsag er vi kommet frem til, at der, når det gælder de idrætsstuderende, er behov for ekstra fokus og vejledning i feedbackprocessen.

Strukturelle udfordringer

Den modulansvarlige på kurset har modtaget megen positiv omtale af forløbet fra de studerende, som opfordrede til at al undervisning på kurset blev gennemført med det her beskrevne peer feedback forløb. Dog mener den modulansvarlige ikke, at dette er muligt, da det kræver, at der er to undervisere til stede om fredagen, hvor holdet må deles op i to for at alle kan nå at fremlægge og give feedback. Den modulansvarlige mener, at to undervisere vil kræve flere undervisningstimer til underviserne. Det var dog vores oplevelse, at vi brugte mindre tid på dette års undervisning, fordi vi ikke som de forrige år selv skulle give de studerende skriftligt feedback på deres skriftlige gruppeopgaver, hvilket tog langt mere tid end de tre timers tilstedeværelse under feedback processen om fredagen. Yderligere er denne ekstra tilstedeværelse ved fremlæggelse og peer feedback om fredagen en god hjælp og forberedelse til ens egen undervisning ugen efter hvad angår brobygningen til sidste uges teori (hvilket er et formuleret læringsmål med kurset). Vi oplevede også, at det var langt mere inspirerende og mindre krævende at undervise på denne måde, da de studerende selv står for det meste af formidlingen og forklaringen og diskussionen af stoffet. Vores rolle som undervisere bliver at skabe gode rammer og retningslinjer for processen. En rammesætning som nu er formuleret på papir og dermed let kan genbruges.

Fremtidige perspektiver

Ud fra vores oplevelser af de studerendes gruppefremlæggelser, peer feedback og diskussion samt ikke mindst de studerendes mundtlige evaluering af forløbet, er vi overbevist om, at denne proces med peer-feedback i stedet for skriftlig feedback fra læreren skaber langt mere engagement og refleksion, og at stoffet bearbejdes på flere forskellige måder. Vi oplever, at disse forskellige former for anvendelse og diskussion af pensum skaber mere dybdelæring, og at det er sjovere for både studerende og undervisere. Vi planlægger derfor at fortsætte med den beskrevne peer feedback metode både på dette kursus og andre kurser vi underviser. En udfordring i forhold til det her beskrevne kursus kan dog være at overbevise de øvrige lærere på kurset om, at det er en god ide at anvende denne metode samt afsætte tid til at være til stede til peer-feedback øvelsen om fredagen før egen undervisningsuge (en nødvendighed på dette kursus pga. holdstørrelsen). En anden løsning på denne udfordring er at afsætte to ekstra timer om fredagen, så ugens underviser kan være til stede ved alle holds fremlæggelser, men den er dog ikke så hensigtsmæssig som den første, da den ikke giver kollegial indsigt i hinandens undervisning, og dermed ikke medvirker til løsning af opgaven med at skabe øget fokus på brobygningen mellem teorierne.

I et fremtidigt perspektiv kunne det være interessant at undersøge ikke bare den oplevede men også den reelle læringseffekt af det beskrevne peer feedbackbaserede undervisningsforløb. Dette kunne gøres ved at udforme nogle spørgsmål, der testede de studerendes dybdelæring. Hvis hele kurset blev ændret, er en anden mulighed, at man sammenligner eksamensopgaverne med opgaver fra tidligere år, for at undersøge forskelle i læringsudbyttet.

A Gruppeopgaver til arbejde med Bourdieus sociologi

Gruppe 1 og 2

I er af Københavns Kommune som hold blevet bedt om hjælp til at løse en af deres aktuelle udfordringer på sundheds og integrationsområdet. Københavns Kommune har gennem de seneste år sat adskillige projekter/tiltagene i værk, for at hjælpe børn i udsatte boligområdet til en fysisk aktiv fritid. Tiltagene har delvist haft en effekt, dog viser det sig at der er en målgruppe som disse tiltag ikke har nogen positiv effekt på overhovedet. Det er gruppen af piger med anden etnisk baggrund. Kommunen står uforstående overfor, hvorfor deres mange tiltag ikke virker på disse piger, og de har derfor bedt om hjælp fra jer, da de har indset at der må ligge nogle for dem skjulte strukturer bag (kulturel, social, økonomisk, kønslig) som er væsentlige at forstå inden kommunen sætter ind med nye tiltag om idræt og fysisk aktivitet målrettet udsatte børn og unge i kommunen. I er delt i tre hold der hver søger at opnå forståelse, så i samlet kan give kommunen et kvalificeret bud på problemstillingen. I har besluttet jer for at Bourdieus sociologi er den rette til at forstå problemstillingen. I skal som gruppe beskæftige jer med nedenstående. Arbejdet skal præsenteres i 5-7 slides med noter, som skal ligge klar til at jeres medstuderende kan arbejde med i refleksions grupperne fredag morgen.

Tag udgangspunkt i den til kurset læste litteratur om Bourdieus sociologi, særligt Engströms undersøgelse i svaret og diskussionen af nedenstående:

Hvordan udvikler man ifølge Engström smag for motion?

Er der ifølge Engströms undersøgelse en sammenhæng mellem de sociale positioner og idræt/motionsdyrkelse i Sverige? Beskriv og forklar denne sammenhæng.

Hvilke parametre har ifølge Engström betydning i forhold til motionsdyrkelse som voksen?

I skal nu overføre denne viden til jeres oplæg til kommunen. Hvad kan i anvende denne viden til, i forhold til den specifikke målgruppe? Forhold jer både til at kommunens tiltag ikke har effekt på den specifikke målgruppe af børn og unge piger med anden etnisk baggrund, men også til at kommunen har en interesse i at dets borgere vedbliver med at dyrke motion også som voksne?

Gruppe 3 og 4

I er af Københavns Kommune som hold blevet bedt om hjælp til at løse en af deres aktuelle udfordringer på sundheds og integrationsområdet. Københavns Kommune har gennem de seneste år sat adskillige projekter/tiltagene i værk, for at hjælpe børn i udsatte boligområdet til en fysisk aktiv livsstil/fritid. Tiltagene har delvist haft en effekt, dog viser det sig, at der er en målgruppe, som disse tiltag ikke har nogen positiv effekt på overhovedet. Det er gruppen af piger med anden etnisk baggrund. Kommunen står uforstående overfor, hvorfor deres mange tiltag ikke virker på disse piger, og de har derfor bedt om hjælp fra jer, da de har indset, at der må ligge nogle for dem skjulte strukturer bag (kulturel, social, økonomisk, kønslig…) som er væsentlige at forstå inden kommunen sætter ind med nye tiltag om idræt og fysisk aktivitet målrettet udsatte børn og unge i udsatte boligområder. I er delt i tre hold, der hver søger at opnå forståelse, så i samlet kan give kommunen et kvalificeret bud på problemstillingen. I har besluttet jer for at Bourdieus sociologi er den rette baggrund til at forstå problemstillingen. I skal som gruppe beskæftige jer med nedenstående. Arbejdet skal præsenteres i 5-7 slides med noter, som skal ligge klar til at jeres medstuderende kan arbejde med i refleksionsgrupperne fredag morgen.

Tag udgangspunkt i den til kurset læste litteratur om Bourdieus sociologi, særligt de opgivne sider i Distinction i svaret og diskussion af nedenstående spørgsmål:

1. Redegør for Bourdieus habitusbegreb. Gør dette med udgangspunkt i teksten og figur 8 s. 171

2. Hvordan får man "smag" for noget? Hvordan forklarer Bourdieu sammenhængen mellem smag, kapital og habitus? Inddrag tabel 16-18 og figur 9 s. 186 som eksempler.

3. Hvordan hænger habitus sammen med livsstil? giv eksempler

I skal nu overføre denne viden til jeres oplæg til kommunen. Hvordan kan i anvende denne viden, i forhold til at opnå viden og forståelse for den specifikke målgruppe af børn og unge piger med anden etnisk baggrund, der bor i socialt udsatte boligområder? Og hvis i skulle hjælpe kommunen med at opnå en dybere forståelse, end den i kan komme frem til af teoretisk vej, hvilke empiriske forskningsmetoder vil i så foreslå skulle tages i anvendelse, opstil en skitse på et forskningsdesign

Gruppe 5 og 6

I er af Københavns Kommune som hold blevet bedt om hjælp til at løse en af deres aktuelle udfordringer på sundheds og integrationsområdet. Københavns Kommune har gennem de seneste år sat adskillige projekter/tiltagene i værk, for at hjælpe børn i udsatte boligområdet til en fysisk aktiv livsstil/fritid. Tiltagene har delvist haft en effekt, dog viser det sig, at der er en målgruppe, som disse tiltag ikke har nogen positiv effekt på overhovedet. Det er gruppen af piger med anden etnisk baggrund. Kommunen står uforstående overfor, hvorfor deres mange tiltag ikke virker på disse piger, og de har derfor bedt om hjælp fra jer, da de har indset, at der må ligge nogle for dem skjulte strukturer bag (kulturel, social, økonomisk, kønslig…) som er væsentlige at forstå inden kommunen sætter ind med nye tiltag om idræt og fysisk aktivitet målrettet udsatte børn og unge i udsatte boligområder. I er delt i tre hold, der hver søger at opnå forståelse, så i samlet kan give kommunen et kvalificeret bud på problemstillingen. I har besluttet jer for at Bourdieus sociologi er den rette baggrund til at forstå problemstillingen. I skal som gruppe beskæftige jer med nedenstående. Arbejdet skal præsenteres i 5-7 slides med noter, som skal ligge klar til at jeres medstuderende kan arbejde med i refleksionsgrupperne fredag morgen.

1. Hvilken rolle spiller kroppen i Bourdieus habitusbegreb? Hvorfor? I kan evt. tage udgangspunkt i tabel 20 på side 203
2.
3. Hvilken betydning spiller kroppen i forhold til distinktionen mellem de sociale positioner og køn?

4. Tag udgangspunkt i teksten og tabel 21 s. 216. Hvordan beskriver Bourdieu sammenhængen mellem sociale positioner, krop og sport/idræt og hvordan kan valg af forskellige sportsdiscipliner forklares ud fra begreberne habitus og kapital?

I skal nu overføre denne viden til jeres oplæg til kommunen. Hvordan kan i anvende denne viden særligt omkring krop og køn, til at give kommunen større indsigt og forståelse for den specifikke målgruppe af børn og unge piger med anden etnisk baggrund, der bor i socialt udsatte boligområder?

B Gruppeopgaver til arbejdet med Giddens sociologi

Gruppe 1 og 2

Anvendelse af Giddens strukturationsteori som en teori om bevægelsespraksis

Vælg en befolkningsgruppe, i en bestemt kontekst (geografisk område, institution el. situation). Med adgangspunkt i Giddens strukturationsteori laves følgende analyse:

Hvilke faktorer på omverdensniveau (dvs. ”strukturelt”) kan influere på individernes bevægelsespraksis?

Hvordan har de indflydelse?

Hvilke faktorer på det individuelle plan har indflydelse?

Hvordan har de indflydelse?

Hvordan er de faktorer af strukturel og individuel karakter, I har identificeret ovenstående, afhængige af hinanden?

Anvend dernæst Bourdieus kapital begreber samt habitus og feltbegreb til at besvare de 5 ovenstående spørgsmål.

Hvilke dele af de to teoriapparater fungerede godt og hvilke dele fungerede ikke så godt i jeres analyse?
Altså, hvilke dele var brugbare og nyttige?

Hvilke af de to begrebsapparater synes I var bedst anvendelige til jeres analyse? Begrund hvorfor.

Gruppe 3 og 4

Giddens beskrivelse af modernitet og selvidentitet

Hvilke begreber er centrale i Giddens beskrivelse af nutidens vestlige samfund (det senmoderne)?

Hvilke begreber er centrale i hans beskrivelse af det senmoderne individs livsbetingelser og livsførelse?

Hvordan hænger disse begreber sammen?

Hvordan kan idrætsdeltagelse være identitetsopbyggende?

Hvordan kan de identitetsopbyggende aspekter ved idræt være konstruktive for individets liv i det senmoderne samfund?

Hvad gør anvendelsen af Bourdieus teori om social praksis det muligt at forklare som ikke lod sig forklare med Giddens teori om det senmoderne samfund og individ? Med andre ord: hvilke forskelle giver det at anvende hhv. Bourdieu og Giddens som teoretiske anskuelser til at forstå menneskers idrætsdeltagelse?

Gruppe 5 og 6

Hvad mener Giddens med begrebet strukturation og hvorfor er der brug for dette begreb?

Er idrætsdeltagelse og dermed denne del af identiteten et frit valg?
Forsøg her først at anvende Giddens strukturationsteori og dernæst Giddens beskrivelse af modernitet og selvidentitet.

Med udgangspunkt i Bourdieus begrebsapparat: Hvilke kritikpunkter kan rejses mod Giddens modernitetsbeskrivelse og teori om individualisering?

Med udgangspunkt i Bourdieus begrebsapparat er idrætsdeltagelse og dermed denne del af identiteten et frit valg?

Mere overordnet set: Hvilke fordele og ulemper har hhv. Bourdieus og Giddens (2) teorier i forhold til at analysere, forklare og forstå menneskers involvering i idræt og fysisk aktivitet?

C Vejledning til peer feedback processen

Arbejdspapir til arbejdet i refleksionsgrupper

I grupperne skal i fredag morgen kl. 9-10 læse og reflektere over det PP-oplæg som jeres medstuderende har lavet. Formålet med jeres arbejde er at udvikle nogle gode spørgsmål som åbner for refleksion og dialog. Benyt jer af nedenstående skabelon:

- Hvor i oplægget er der punkter, der vækker jeres interesse og som i godt kunne tænke jer at høre mere om. Hvorfor synes I det er interessant?

Nævn en eller flere ting, som I gerne vil have oplægsholderne til at uddybe/beskrive i flere detaljer. Det kan være emner I er særligt nysgerrige efter at vide mere om, noget I finder spændende, gådefuldt, etc.

- Hvordan spiller oplægget sammen med jeres eget arbejde med casen? Kan I se ligheder/forskelle, er der eksempelvis i oplægget medtaget nuancer, som I ikke har været omkring og/eller er der forhold som I inden for de præsenterede emner har diskuteret, der ikke er nævnt i oplægget?

Nævn en eller flere af disse områder, hvor I enten ser ligheder eller forskelle, og hvilke refleksioner det har sat gang i hos jer

D Oversigt over forløb med studenter fremlæggelse og Peer-feedback

22

Testing and evaluating peer assessment of chemistry exercises

Martin P. Anderson

Nano-Science Center, Department of Chemistry, University of Copenhagen

Background

During the fall of 2013, I taught a course called Nanotermodynamik, which is a basic chemistry course in the NanoScience program. I was responsible for helping the students during the exercise classes, correcting exercises and I also gave one lecture. Every week there was a set of exercises for the students to do. Most exercises were solved during a weekly session, where I was present to help the students. If some exercises were left, they were solved at home. The exercises were of varying difficulty; ranging from "plug-in-the-formula once you find the right formula" to more challenging exercises, including purely conceptual questions.

One of the more difficult exercises was to be handed in to the teacher. The normal procedure would be that I would correct these hand-in exercises and give them back to the students with some feedback. The exercises already provide opportunity for deep learning compared to traditional lectures, reaching primarily the lower three levels of Bloom's taxonomy (figure 22.1): Knowledge, comprehension and application (Alford et al. 2006). Classical lectures normally lie on the first and perhaps the second level.

The choice of exercises to be handed in has previously been chosen by the teachers in charge. They have taught the course before and have experience in choosing exercises of appropriate difficulty.

The project

I decided that my project in the *Adjunktpædagogikum* course would be to implement peer assessment of the chemistry exercises as an attempt to include even higher-level learning for the students compared to normal problem solving. The idea was to let the students assess (and thus be assessed by) someone at their own level. I decided that the form of assessment should be written constructive feedback and corrections to a student's solution of an exercise. I would then collect the exercises and give feedback as well.

In order for this to work, one important requirement was to have exercises that were suitable for peer assessment. This meant that the exercises required that the students needed to write down assumptions, procedures and calculations and that the exercise should be rather difficult, but still manageable to most students. I had a look at the exercises that were going to be handed in during the course and made the judgment that they were suitable for my purposes.

Motivation

The motivation for my choice of pedagogic experiment was two-fold:

- Students generally write for teachers, implicitly assuming that the reader knows more than they do. This can lead to poorly presented exercises that are difficult to correct. This approach to solving exercises is not beneficial for students in the long run. I believe that it is very important to be able to present your work well, and that it is a skill that should be acquired as part of your education. When writing for their peers, I hoped it would make the students present their exercises better, with more emphasis on complimentary figures and explaining text. Not only would this help the students in their learning and future career, but it would make my life easier when correcting the exercises. Assessing peers as well as being assessed by peers is also very common practice after graduation, in academia and in industry and is therefore a skill that should be familiar to the students.
- The second point is that peer assessment of other students' exercises allows for learning at higher levels according to Bloom's taxonomy (Figure 22.1), compared to just doing the exercises themselves. Even the highest level can be reached when assessing other students' solutions to exercises, in particular when the two students have found different solutions.

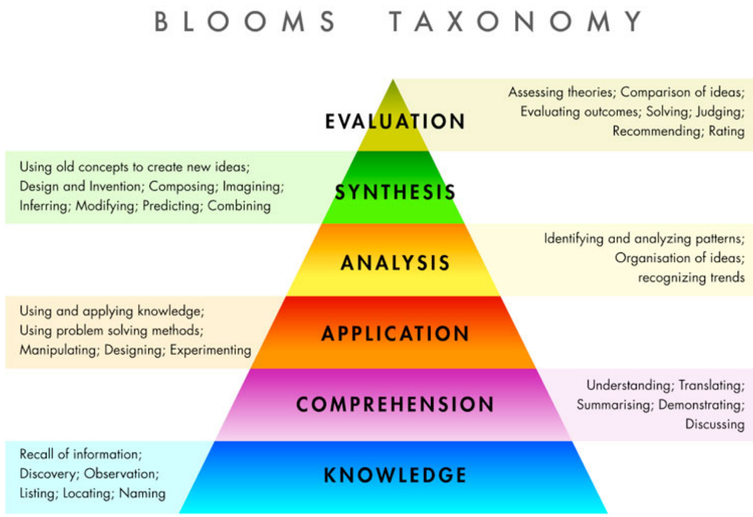


Fig. 22.1. The six levels of learning according to Bloom's taxonomy (Alford et al. 2006). The higher up the pyramid, the deeper the learning is.

Implementation

As mentioned previously, there was one exercise per week to be handed in. The teachers in charge chose which exercise, but I was able to provide my input and advice as well. The peer assessment was implemented for the first five weeks out of seven. The last two weeks, the exercises were handed in directly to me, without peer assessment, for practical reasons.

The distribution of exercises was semi-random. All exercises were handed in to me and put in a pile. The pile was sent back to the students, who were asked to take one exercise to correct and comment on, and pass the exercise pile on to the next student. Naturally, they could not choose their own exercise. The time allotted to the peer assessment was one week, and then the exercises were handed in to me for final corrections and feedback. The following week I gave the exercises back to the students, including comments on the feedback made during the peer assessment.

At the beginning of the course, I tried to help the students how to give constructive feedback. I gave examples of the sort: I would have appreciated a figure here… You could use some more explaining text… I also mentioned that it is much more helpful to explain *why* there should be a negative sign on that number, rather than just stating that it is wrong.

Results

There were no objections raised when I informed the students about the experiment, and the peer assessment generally went well. I did feel that the peer assessment lacked organization, and one or two exercises were lost for some time before resurfacing when the student who had the exercise finally found it.

The solutions to the exercises were very well presented when compared to another chemistry course I taught at KU. Many exercises had illustrative figures, which are not normally seen in students' solutions to exercises. This was appreciated by the students as well and consequently led to very good assessments, where most students reacted positively and commented on figures, tables and explaining text.

In order to provide me with some more detailed feedback, I decided to evaluate the outcome of my experiment in the form of a written survey given to the students at the end of the course (before the exam...). The five questions that were intended to give me qualitative feedback were:

1. What did you learn from performing the peer assessment of other students' exercises?
2. Did you present your answer to the exercises differently when you knew your classmates were going to assess the exercises?
3. What did you like about the peer assessment?
4. What could be improved with the peer assessment?
5. Any other general comments?

Answers

I have assigned the students' answers to the first three questions as being positive or neutral/negative towards the peer assessment tasks. The quantitative summary is found in Table 22.1, and the results show that the peer assessment was well received and appreciated by the students, but that most of the students did not present their solutions to the exercises any differently than they would have if handed in directly to the teacher.

Question	Positive response	Negative/neutral response
1	13	9
2	7	15
3	15	5

Table 22.1. Quantifying the responses to peer assessment of chemistry exercises from questions 1-3 of the survey.

The full answers from the students can be found in appendix A. I have translated the answers that were in Danish into English for the sake of consistency.

Evaluation of the results

Many of my expectations and observations were confirmed by the survey. The pedagogic goals were largely met, as some students commented that they learned the course material better thanks to the peer assessment. Many also wrote that they learned how to present their solutions in a better way, which was also one of the project goals.

Fewer students than I had expected mentioned that they changed their way of writing the exercise when they knew that their peers were going to assess them as well. This is slightly at odds with the comments from question 1, which indicated that many students noticed how important a good presentation actually is and that they learned how to present their solution better.

The majority of the students liked the peer assessment. They mentioned that they learned more, and that it was fun and stimulating to assess and be assessed by peers. Only one student expressed severe discontent about the peer assessment.

The most occurring comment about what could be improved was that the organization could be better, which confirmed what I had noticed myself. A few students mentioned that it could have been better to assess a different question than the one they solved, while some liked to assess the same exercise they had solved, because they could compare solutions.

Actions for next time

It was quite nice to see that the survey answers agreed so well with my own observations. The main thing I need to change is to make the organization and handling of the peer assessment better. No exercises should be lost, and even if students misplace them, it reflects badly on the teacher. The learning outcome for the students improved, which means that the concept of peer assessment is very promising and should definitely be used as a teaching and learning activity again the next time I teach the course.

Based on my own observations and the students' survey answers, I have the following suggestions for improvements for next time:

1. The peer assessment has to be more organized. One suggestion is that the students can hand in directly to me, and I will copy or scan the exercises and hand out the copies to the students. This alleviates the problem of assignments getting lost. The feedback could then be done either online or directly on the copied assignment. I will also implement some kind of bookkeeping of who assesses whom, in order for the students to assess different people for each exercise.
2. All students assessed solutions to an exercise they had already answered themselves. I am going to try to divide the class into two groups and for some weeks give two different exercises to hand in, one for each group. Then the two groups will assess each other and the students have the opportunity to assess an exercise they have not solved themselves. In the evaluation we will then be able to compare what the students think is best – same questions or different questions.
3. In addition to the brief lecture when introducing the peer assessment, I will also hand out a written explanation of how to give constructive feedback for the exercises. This can help the students when performing the assessment.

Summary

I implemented peer assessment for chemistry exercises in the Nanotermodynamik course, which is part of the NanoScience program, where students had to give feedback on each other's exercises before handing them in to me for correction. While the implementation and organization could be improved, the peer assessment was well received. I made a survey after the course that showed that the students achieved deeper learning and how to better present their work, which means that the main goals of introducing peer assessment were achieved.

A The students' answers to the survey

1. What did you learn from performing the peer assessment of other students' exercises?

Positive answers:

- It helped me remember the exercise a little better.
- I have learned be more elaborate when explaining my calculations.
- I picked up a few tricks in how to format homework in a more well-arranged way.
- Nothing much in terms of chemistry, but it was nice to get practice in evaluating other peoples work.
- I found out how to present a solution to an exercise in a nice way.
- I learned that even though the calculations are right, many small details can be missing.
- I learned from the methods (approaches) that they employed, i.e. explaining with text.
- It's nice to see someone else's way of answering the questions.
- I had a different look of the way to solve problems.
- A higher understanding of the material in the assignment. Having to correct another student's paper makes you think twice about the answers whether your own answer was correct or not.
- Not so much, but it was fun to see other people's solutions.
- Different way to do exercises, but they were in general too short to have big differences.
- I learned how important it is to write explaining text.

Negative/Neutral answers:

- There were only a few exercises made by a couple of people, and those were not too good. But practice helped.
- I wasn't sure anyway whether my own calculations were correct, so I had some difficulty in correcting other's exercises.
- Not so much. If the assignments are a little more complex I would learn more. It is about learning what's hard. The few assignments of the course were constructive.
- The idea is good, but not in practice. One corrects the exercise with one's own solution in mind. Therefore I learned nothing new.
- Not really anything. The ones I corrected were very similar to mine. But theoretically I could have learned different ways to approach the exercises.
- I found it difficult, because I was not sure my own answer and calculations were correct.
- 3 people stated that they had learned nothing.

2. Did you present your answer to the exercises differently when you knew your classmates were going to assess the exercises?

Positive answers:

- The answers had to be clear

- I found it nice to compare your own results and approaches to other students in the class. The results might be the same, but the approach can be different.
- It reflected some of the things I picked up from seeing others format, otherwise not.
- Slightly more explanation.
- Trying to keep a level of organization throughout the paper.
- I probably wrote more elaborately.
- I made a nicer layout and made my calculations clearer, as this was something I myself found important when assessing.

Negative/Neutral answers:

- No, I expected the teacher would also assess the same work.
- 14 people answered: No

3. What did you like about the peer assessment?

Positive answers:

- You see a different way to solve the same problem sometimes.
- Because it showed facit and how to solve the exercises.
- I like the help and exercises from teachers and I love Peer Wise.
- I picked up a few tricks in how to format my homework in a more well-arranged way.
- I liked getting some feedback on my work before it was handed in to the teacher. This way errors or misunderstandings could be fixed so I didn't have to hand in the exercise again.
- I found out how to present a solution to an exercise in a nice way.
- The possibility to see how details can vary.
- You could find alternative ways to calculate the exercises.
- The things you didn't know beforehand, and checking your own knowledge of the subject.
- It's nice to see someone else's way of answering the questions.
- A higher understanding of the material in the assignment. Having to correct another student's paper makes you think twice about the answers whether your own answer was correct or not.
- A different way to do the exercise, which was fun.
- That someone your own level corrects your exercises.
- One could see that one had the same idea for solving the exercise.
- It was nice to see other peoples way of thinking and different ways to solve the exercises.

Negative/Neutral answers:

- Honestly, not much… didn't really receive constructive feedback.
- I'm ambivalent.
- 3 people wrote: Nothing

4. What could be improved with the peer assessment?

- Had to hold on to others homework for a week when it only took ~10 mn to correct sometimes.

- It is difficult to know whether your exercise was corrected because you could not know if it was handed in to the teacher.
- Better feedback.
- It was a bit annoying that the one assessing your exercise didn't deliver it on time. It was therefore not listed as delivered and you would not get it back in time.
- Get rid of peer assessment.
- That the peer assessments are corrected by a teacher and not students, who forget to redeliver the assignments.
- I wasn't sure that your exercise was delivered for correction to the teacher.
- I didn't find it consistent enough. If it was to succeed it should be organized better. It needs a system that can be kept.
- The layout could be nicer.
- It should be more structured. It quickly got unorganized with what exercises you should deliver for others I yourself. It got mixed up!
- More structured way of delivering each others' exercises, as one can easily miss delivering the assessed exercise.
- Make it more controlled, so that you know if your exercise has been approved. More structure would be nice.
- Perhaps a full solution would be nice to use as a guide for assessing the exerices.
- Better organization to make sure which exercises were delivered. Even if an exercise had been delivered the teacher's notes could say not delivered.

5. Any other general comments?

- It is a bit risky to put the responsibility for your exercise to another student, if they misplace it, but altogether a very nice way to you're your exercises corrected.
- It was nice to se each others' exercises, but perhaps 15-20 minutes during class should be spent looking at each other's exercises and deliver it the same day to make sure it was handed in.
- Great idea, but keep it more consistent!

23

Peer evaluation - a teaching element increasing the formative evaluation of the students

Håkan Torbern Tagesson

Faculty of Science, University of Copenhagen

Introduction

To increase the understanding and learning outcomes of the students, there should be a constructive alignment between the teaching activities and the intended learning outcomes for the student (Biggs & Tang 2011). Passive situations, such as traditional lectures and tutorials, should be avoided, and instead, exercises, discussion groups and other teaching elements where the student is an active part of the learning process should be used (Biggs & Tang 2011). It is when the knowledge is used actively, that a deeper form of understanding is reached. One such active form of teaching is peer evaluation, when the students are making an assessment and evaluation of other student's work.

Investigations have shown that the deepest understanding from feedback is gained by the person who gives the feedback and not the person that receives it (Rienecker et al. 2013). The analysis showed that feedback is more encouraging and helpful when given by a peer, than the feedback given by a teacher. Race (2001) mentions 7 main points to why teachers should bring in students in the evaluation of the student work. 1) the students are already evaluating their own projects while working on it. From this point of view, it is waste of resources not to give the students some tools for this evaluation which is anyway a part of their work (Sjøstedt 2013). The students reach a deeper form of understanding when evaluating their own and others work. 4) The students get a deeper understanding for the evaluation methods and of how their own work is evaluated by the teachers. They are no longer passive observers of the evaluation method, but instead a part of it. 5) The students will be more independent by being an active part and contributing to the evaluation of their studies and learning. 6) The students gain life-long skills that are important for their career, such as assessing colleagues work, team building, etc. 7) The students get more feedback than if the teachers only would give the feedback. Generally, there are large class sizes and teachers have a tight schedule. It is thereby difficult for the teacher to give a proper feedback to everybody. By adding peer feedback as a teaching element, the students get more feedback than would otherwise be possible.

The main aim with this study was to investigate if a peer evaluation exercise gives a formative evaluation of the learning processes. I have three hypotheses; 1) the peer evaluation exercise will result in that more students get a proper feedback; 2) the feedback given by the other students are better than the feedback given by the teacher; 3) students working with similar methods and topics will give better feedback than students working with different methods and topics.

Material and Methods

I am responsible for planning and executing a course within remote sensing at the Department of Geosciences and Natural Resources at Copenhagen University. The course is given during Blok 3. During Blok 2, a similar course within remote sensing was given. Both courses have the same structure with some lectures and exercises, whereas a large part of the courses are based on a student project work. During the project work of the course given during Blok 2, the students were told to hand in a preliminary report two weeks before the deadline of the final report so that the teacher could give them some feedback and make some formative evaluation of the learning processes. However, this did not work out very well, and it was only one student group which handed in the preliminary report, the rest of the students did not hand in anything at all. For the final deadline, all groups handed in their report. In order to test my hypothesis that more students will get feedback than if only the teacher would give feedback I will compare the number of students getting feedback to the number of students getting feedback in the previous course.

The course during Blok 3 has 11 students in total and they are writing eight different projects. The course is also a preparatory course for their final master thesis, and the students were thereby allowed to choose if they wanted to write in groups or individually. Two weeks before the final deadline I had a preparatory session for the peer evaluation exercise. During this session, the students were introduced to how to make an evaluation, and reasons for why they were doing a peer evaluation instead of me giving them the feedback. They were given the exercise instructions (appendix A), and the schedule for the exercise. Ten days before the final deadline of their project reports, they were told to exchange reports with their peers. I divided them into groups. In order to test my hypothesis that students working with similar methods and research questions were better in giving feedback to each other than students working with different topics, I divided them into 2 groups working with similar topics and methods and two groups working with different topics and methods. Finally, in order to test the hypothesis that the student's feedback was as good as the teacher's feedback, I posted at Absalson that the students, who want feedback from me, can send me their preliminary report and I will give them feedback as well.

Finally, I handed out an anonymous questionnaire to the students (appendix B). I asked them to respond to general statements if the peer feedback had helped them in their project, possible improvements of the exercise, if their peer worked with similar methods and topic, and which feedback was the best the peers' or the teachers'.

Results

Hypothesis 1. The peer evaluation exercise resulted in that more students got feedback

One group of students got feedback on their preliminary reports during the Blok 2 course, whereas during the peer evaluation exercise, 10 students out of 11 got feedback. The final student that did not get any feedback announced the week before that she will not hand in any report before the final deadline. Additionally, most students thought that the feedback from their fellow peers helped them regarding most parts of the project work (Figure 23.1). Generally, it can be said that the students were more satisfied with the general feedback of their report, rather than feedback regarding methods and evaluation of their results.

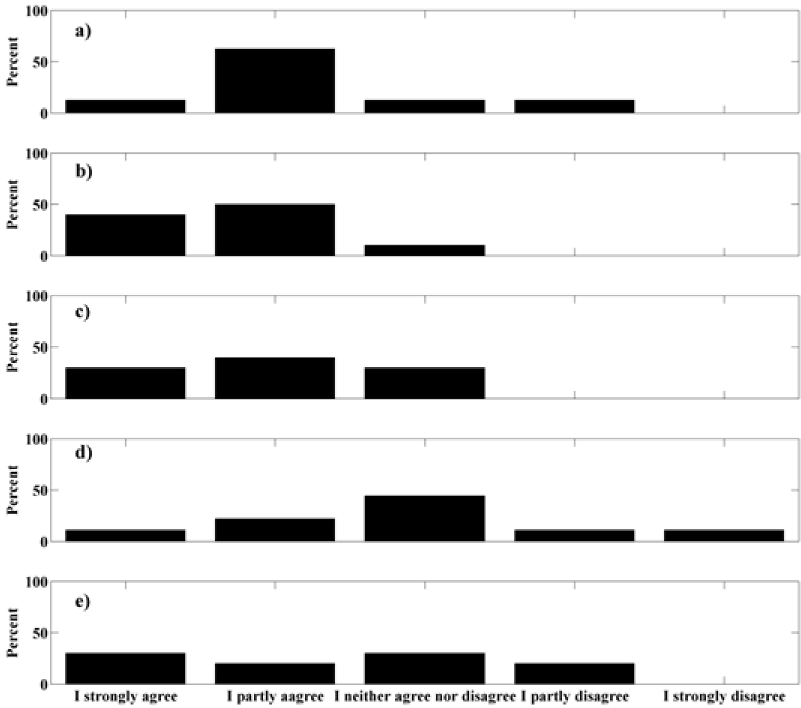


Fig. 23.1. The fraction of how students responded to the statements; a) "The feedback from my peer was very helpful for writing my final report", b) "My peer gave me good general feedback"; c) "My peer gave me good feedback on specific points in the report"; d) "My peer helped me in solving methodological and technical issues"; e) "My peer raised questions related to my research question which helped me in the evaluation and discussion of my results"

Hypothesis 2. The feedback given by other students were better than feedback given by the teacher

There were no students that used the opportunity to send me their preliminary report. I can therefore not verify that students give better feedback than I do. However, in the questionnaire I included a question comparing the feedback they got from their peers in relation to the feedback they usually get from teachers (Figure 23.2). Some students did not want to comment on this at all. Three students thought that it was better, whereas four students thought that the teacher's feedback usually is better. A student that thought that the teacher's feedback was better wrote in the comment field that, "both were helpful in different ways. The peers were mainly for motivational reasons and to help focusing on the structure". However, students that preferred the feedback from peers instead wrote "More in-depth [feedback] compared to normal standard from teacher and more discussion". Another student wrote "That was a very good exercise and I appreciated the feedback from my peer".

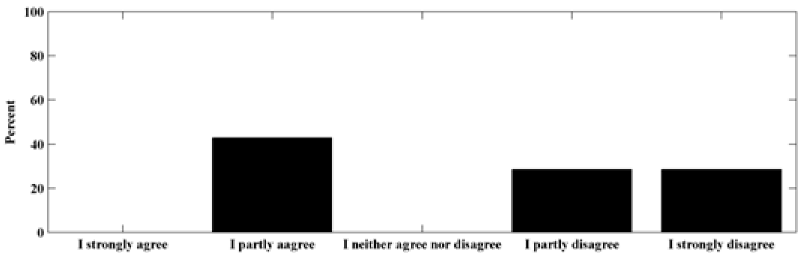


Fig. 23.2. Fraction of how students responded to the statement "The feedback from my peer was better than the feedback I usually get from a teacher".

Hypothesis 3. The feedback from students working with similar project was better than feedback from students working with different projects

In general, basically all students thought that their peers gave them good general feedback (Figure 23.1 b), so it did not matter if the topic of the peers were similar or not. There was a trend that the peers that used similar methods were better in giving feedback regarding methodological and technical issues than the peers that used different methods (Figure 23.3). This was not statistically significant though, partly due to the small sample size.

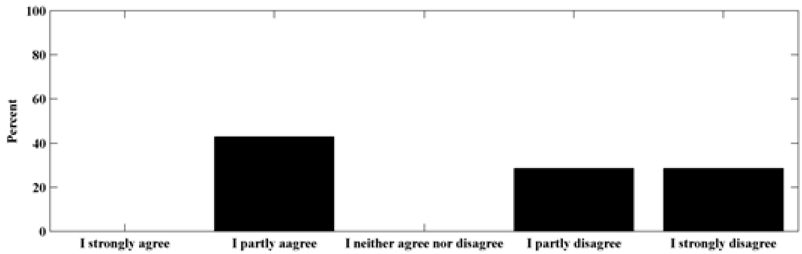


Fig. 23.3. Fraction of how students using similar (black) and different methods (grey) responded to the statement "My peer helped me in solving methodological and technical issues".

Discussion

It can be concluded that the exercise in general was successful. I can conclude that the first hypothesis is verified. Most students got feedback and all students agreed to at least one of the statements given in Figure 23.1, indicating that all students got some help. Additionally, most students strongly agreed on many of the statements indicating that many got a lot of help. An issue with the feedback exercise was though that the students exchanged reports ten days before the final deadline. This was set so that the students would be able to incorporate feedback into their final reports, but it also resulted in that all groups came with unfinished reports. A comment by one of the students from the questionnaire was "Focus feedback technique on more unfinished products", which is probably a good idea. In the instructions handed out to the students (Appendix A) focus was on how to evaluate a finished project. This is something that could be made better in the future. This is also a likely explanation to why the students did not hand in any reports for feedback during the course in Blok 2.

The results of the questionnaire do not allow me to draw any conclusion regarding the second hypothesis that students are better than teachers in giving feedback. Many students think that the teacher is better in giving feedback than their peer, whereas some think that their peer was better. I think that an explanation can be that many students still think that teachers are the authority and they know the "truth". This is naturally not the case, and I think that master level students, which are very used to write reports, know if their reports are well done or not. They are thereby highly capable of giving proper feedback (Race 2001). If the teacher would have a lot of time, the evaluation could be well done, but because of a tight schedule a fellow student with time gives better feedback.

I can falsify the final hypothesis in that students working with similar topics were gives better general feedback. For giving general feedback, you do not have to know a lot about the topic. It could possibly even be the other way around, that if you do not fully know the topic, it is easier for you to ask the stupid questions that help your peer in the project evaluation and the structuring of the project report. The second part of this hypothesis that students working with similar methods are better in giving feedback than others, can neither be falsified not verified. There was however a tendency towards getting better feedback from students working with similar methods. The methods are not as easy to grasp and knowing about the methods beforehand, thereby most likely help the student in giving the feedback.

I would generally say that this peer group exercise gives a formative evaluation of the learning processes. To give feedback makes the students more prepared themselves. By thinking of how others have structured their reports, it is easier to structure an own report in a clearer way. Giving feedback help improve critical thinking. The exercise is a thereby a tool for them to make a better final report. Additionally, it is time effective in that students have time for preparing the feedback of one report, whereas giving feedback to ten projects, or more, for the teacher is very time consuming. This study showed that it is possible, and with good results, to include the students in the evaluation process. It was motivating both for the students, that enjoyed both getting and giving feedback, and for the teacher that freed some time from the schedule.

A The teaching material handed out to the students

Peer Group Exercise- Remote sensing Seminars and Project work 2014

You are expected to carefully read and analyze your peer's project report, and to give your personal views. Your review should contain the following four points:

1. Concise summary of the report.
2. Evaluation of the report (assessment, positive and negative sides, unclear points regarding contents, structure, language, figures etc.).
3. Summary (accept/not accept, why).
4. Further comments (typos, hints for improvements).

Remember that the purpose of the exercise is not to condemn project reports or authors! The purposes of the peer group exercise are to:

1. Help the authors to make a better report.
2. Train to read reports, to try to understand them and learn to do a review.
3. Train the authors to take advice from others.
4. Learn how to write (and how not to write) from others.
5. Spread the content of report.

Questions to consider:

1. Does the project follow the standard structure of a research article including: Introduction, material and methods, results and discussion?
2. Is the scope of the project within the framework of the course?
3. Does the project address a valid problem or research question?
4. Has this study been done before?
5. Will readers be able to understand the report as it is written?
6. Should the project report be accepted?
7. If it is not to be accepted- how can the authors write a better project report?
8. If it is to be accepted- how can the authors help readers to understand the report more easily?
9. Are there related questions that the authors might want to address? Is there any related work that the authors might not know about?

Overall:

Be concise, but specific. If the report is not so well written, do not just say that it is bad. Specify what is not so well done. Tell them that it would have been better if... If a statement is incorrect, give a correct example. Be polite, remember the authors are humans and getting a bad review is a not a nice experience.

B The questionnaire

Remote sensing seminars and project work *Evaluation form for the peer evaluation exercise*	I strongly agree	I partly agree	I neither agree nor disagree	I partly disagree	I strongly disagree	No comment
The peer evaluation exercise helped me structure my final report.						
The peer evaluation exercise helped me getting started with the writing and analysis.						
My peer gave me good general feedback.						
My peer gave me good feedback on specific points of the report, (e.g. figures, language, etc.).						
My peer helped me in solving methodological and technical issues.						
My peer raised questions related to my research question which helped me in the evaluation and discussion of the results.						
The topic of my peers report was similar to the topic of my report.						
The method of my peers project was similar to the method of my project.						
The feedback from my peer was very helpful for writing my final report.						
Is there anything that could have been better with the exercise? YES					NO	
Clarify						
Did you get any feedback from the teacher? YES					NO	
If yes: The feedback from my teacher was very helpful for finishing my final report.						

If yes: The feedback from my peer was better than the feedback from the teacher.						
Clarify						
If no: The feedback from my peer was better than the feedback I usually get from a teacher.						
Clarify						
Additional comments:						

Thank you very much

24

Different forms of assessment for transferring students' ownership of learning assessment and developing their skills

Thai Thi Minh

Department of Resource Economics and Food policy, University of Copenhagen

Introduction

Assessment has been established as the most important skills for students' effective learning and for future professional development and lifelong learning (e.g. Sluijsmans et al. (1998), Dochy et al. (1999), Taras (2001, 2003), Amo & Jareno (2011)). When aiming for developing student assessment and learning skills, assessment should be a central element of the learning process in which students need to demonstrate their learning outcomes through the presentation of material appropriate to the task set, and to reflect upon their progress and utilisation of information to make individual judgements on the need for additional effort (Fallows & Chandramohan 2001). In this sense, it is an assessment for learning which is referred as a process in which teacher and students recognize and response to student learning during that learning (Willis 2007, 2011, Cowie 2012). Assessment for learning requires the use of different forms of formative assessment to obtain information about the students' learning, to know how to help the students to improve their learning and to develop their learning skill for the long-life learning (Lopez-Pastor et al. 2013). Among different forms of assessment, self-, peer-, and co-assessments are popular forms that have been intensively used in the high education setting.

There has been a massive work done in using and analysing role of self-, peer-, and co-assessments in creating an active learning environment, assisting students' achievement of learning outcomes, developing students' assessment skill, improving students' writing performance, (eg. Sluijsmans et al. (1998), Lindblom-ylanne et al. (2006), Esfandiari & Myford (2013)).

It is generally argued that the most difficult aspect of self-, peer- and co-assessment is to determine the criteria and instructions for students' assessment as:

> *'Criteria are the basis of evaluating student progress; they identify the critical aspects of a performance or a product that describe in specific terms what is involved in meeting the learning outcomes' (Sluijsmans et al. 1998, pp. 315).*

> *'The specific criteria and good instructions for students seemed to enhance the accuracy of self- and peer-assessment' (Lindblom-ylanne et al. 2006, pp. 59).*

In my own teaching, I have constantly observed that students have been reluctant to assessing their own demonstration of the on-going learning process. Consequently, I have gradually taken over the students' assessment ownership. Hence, it leads to a tendency of students escaping from any forms of assessment, assuming that assessment is the teacher's tasks and responsibilities. Analysis of the formation of student assessment's activities/sections in the course I am teaching has shown that criteria of and instruction for these assessment do matter for the students' autonomy in the assessment process. In other words, the current forms of non-framing assessment criteria and instruction that I am using now do matter for the students giving up their ownership of learning assessment (OLA).

This project aimed to (1) analyse how different forms of assessment and instructions help to transfer OLA back to students and (2) identify what skill can be achieved when using different forms of assessment.

Project's context and design

he project was set in the Agricultural Value Chains in Developing countries course held in April-June 2013 with participation of 31 MSc. students from agriculture-related MSc. programs in University of Copenhagen and other Universities in Denmark. The course was designed with two parts: lecture and practice. In the *lecture* part, students learn value chain-related theories through the lectures, and reflect the theories through group work and case studies. In the *practical* part, students applied these theories to their group project for developing their skills and competences on analysing the selected value chain and communicating the results. A common situation in the group project is "*one or few work for all*" and then the group project might not fulfil its role in students' learning. Students experiencing this issue have showed less motivation to take part in such type of activity. To avoid this as well as to motivate students' active participation in the practical part, each student in the course had to write an individual assignment documenting results from the group project and reflecting on the process the group had been through. The individual assignment was graded and accounted for 40% of final grade. Moreover, the individual assignment exercise is training for the students' in preparing for the final exam. The 12 hours open-booked exam was designed for giving the students' opportunities to strengthen further the knowledge, skills and competences developed throughout the course as well as demonstrate their ability to develop and use a case-specific analysis framework for the value chain analysis.

Under this course's setting, student's learning assessment was conducted in various activities/sections in the practical part of conducting group project (GP) on "analysing a selected value chain for developing an intervention strategy". The GP was a step-wise process of 1) forming group and selection of an agricultural value chain in developing country for analysis, 2) developing and presenting initial design of GP, 3) analysing the selected value chain, 4) presenting the GP initial results, and 5) presenting final results. Experiment on using different forms, criteria and instructions of students' learning assessment was held in step 2, 4 and 5 in that students assessed their work on the group project and their learning achievement throughout the course as presented in table 24.1.

As presented in table 24.1, three forms of assessment were used in the experiment. The *first* form is co-assessment in which teacher took the leading role in developing assessment criteria and managing the oral feedback; assessment criteria was general and unclear objective towards the student's learning propose; and assessment's instrument was organized in the collective manner and under the format of one-way-communication oral feedback. The *second* form was peer-assessment in which teacher set a general frame of the assessment's aims, tasks that student need to do, and timeframe for these tasks; the students proactively set own-criteria for assessment either collectively (in groups of 4 to 5 students) or individually towards improving their GP results; and assessment's instrument was organized in the interactive manners with plenary discussion based on the group-based written feedbacks and issues raised during the presentation and discussion. The *third* form was self-assessment in which teacher set specific assessment criteria that help the students reflects on knowledge, skill and competence that

Assessment's order & form	Context for assessment	Criteria	Instructions/ instrument
1. Co-assessment	*1st event*: 7 group presentations of project design in 105 minutes	Criteria are set by teacher: • What are unclear?	Oral feedback
	2nd event: 6 group presentations of initial group project results in 150 minutes	Criteria are set by teacher: • What are unclear? • What are interesting? • What need more work/focus?	Oral feedback
2. Peer-assessment	*1st event*: 7 written group presentation about final group project results	Criteria are set by each group toward to improve the group project performance/presentation	Group-peer assessment with discussion and written feedback
	2nd event: 7 oral group presentation about final group project results in 210 minutes	Criteria are set by each student toward to improve the individual assignment performance	Plenary discussion after group presentation
3. Self-assessment	*1st event:* 1 hour group-reflection on the learning process during the course	Criteria are set by teacher: • What do you learning from the course? • What do you achieved from the course?	Delphi with cross-checking among students participants
	2nd event: Individual reflection on group project and individual assignment (of out the group project)	Criteria are set by teacher: • What are the knowledge, skills, and competences that students have obtained that are important for their future professional life? • Could the group project be organized in a way that would help you obtained the knowledge/skills/ competences better? • Should teachers organize the group project differently in the future?	Self-reflection with the delivery of a written essay

Table 24.1. Design of the experiment.

they had learnt from the course as well as a critical assessment to their own learning process; assessment's instrument was lied in the students' individual reflection on their achievement and learning.

Data was collected during different times of learning assessment under the form of 1) notes taking during the oral feedback and plenary discussion; 2) group peer-review's written feedback; 3) individual self-reflection essay, and 4) notes collected from group-reflection using Delphi method. The analysis and interpretation was conducted based on framework presented in the figure 24.1.

Results

24.0.1 Relationship between assessment forms and students' OLA

In my observation, the students' OLA is reflected through their attitude towards and their participation in the feedback event as well as the rele-

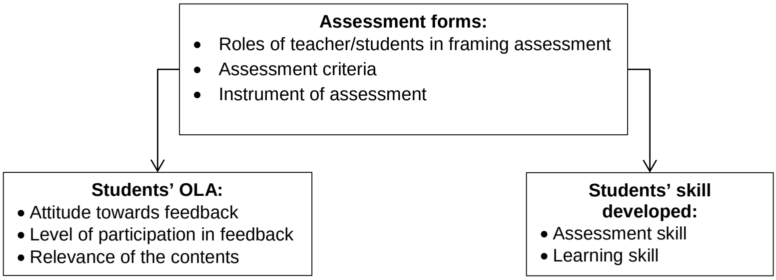


Fig. 24.1. Framework for analysing relationships between assessment forms, students' OLA and skill developed.

vance of the feedback's contents that they delivered. In the setting of co-assessment events, the students who had to give feedback showed their unresponsive attitude to the feedback section. In the first co-assessment event, there were no comment and feedback from the student audients for presentation; only four questions were raised from the audients that mainly classified the technical information in related to value-chain-related terminologies. In the second co-assessment event, there were 8 questions raised for classification of information related to specific value chain presented and fours comments for further works to improve the GP results. Interestingly, these comments were given to two presentations that spontaneously specifically asked for at the beginning of their presentation. These results indicated a very passive participation of the students in the feedback events as well as irrelevance of the feedback contents. It could be firstly because of unclear feedback criteria and tasks that had gave to them and they really did not have time to think and to prepare for their feedbacks. Secondly, students were not given enough time to think about feedbacks. These hindered the students' participation as they tended to assume that it is the teacher's responsibility to give feedback to students. Consequently, the students who received the feedback showed their carelessness about comments they got from the student audients. In the setting of peer-assessment events, the students showed responsive attitude and active participation level, from both sides of giving and receiving feedbacks. The feedback-giving-students delivered their "group-based review reports" on time and with very clear themes on positive and negative points of the group presentation that they have to comment on. Although the format and the way of communication their feedback messages varied from reports to reports, most of the reports showed a comprehensive level of analysis what they get from the given presentation and thoughtful construction of the feedbacks as showed in some examples (taken from one feedback report) of feedbacks addressing very specific and micro issues (see example 1), others with very complicated and sophisticated issues at the overall level (see example 2), while some feedbacks highlighting complicated issues in the specific slide in the presentation (see example 3).

> *Example 1: "Slide 13: nice with prices in kg/DKK; slide 20: seem very smart. What does the number present?"*
>
> *Example 2: "institutional analysis or analysis of enabling environment you did should be a more focus on this area, either both or just one of them; use one of the tools from lectures; more details on specific policies, organisations and institutions for Madagascar and the vanilla production".*
>
> *Example 3: "The difference between institutional arrangements and institutional environment doesn't really become clear from slide no.15 (is it national vs. private 'policies')? If so, Food safety standards and financing policies can be both we think".*

Clearly, almost all feedbacks were highly relevant as the feedback-receiving students highlighted what comments they incorporated for improving their presentation and what comments they did not and the reasons for that. Several groups of students mentioned that as they was informed that another group will make review and commenting on their presentations, they had prepared presentations thoughtfully as they do not want to get many negative feedbacks. Thus, clear tasks, specific constructive criteria towards improving the GP performance and the high level of interaction in the feedback process have helped to develop responsive attitude and actions, and active participation of both giving and receiving students, which in turn, clearly positively impact the relevance of comments as well as the institutionalization of these comments.

In the setting of self-assessment, the students showed high self-motivation and self-criticism in both assessments events of using Delphi method and writing essay. They showed their interests in, ownership to, and competence in making critical assessment to their learning achievement and learning behaviours. For example, in the first event, the students critically pointed out and discussed about their initial opposed attitude and reactions to the deep learning approach had been applied and how these were changed during the course as one student stated:

> "At the beginning, even when going through the half of the course, I was very irritated about exercises, group discussions, brainstorming, etc. I talked with other students and they also agreed with me that these activities are annoying as we do not get use to them before. However, when moving to the second half of the course, I realized that these activities did help a lot in digesting information and tools obtained in the course. At the end, I really like this way of teaching, especially when we did the brainstorming section on dynamics of value chain analysis and how to apply it in the reality last week."

Discussing on this point, the students agreed that it was the common 'sense' occurred in this class. This reflection was also highlighted by a number of students in their self-assessment essays as stated in one example below:

> "During the course I mainly struggled with understanding the whole idea of the analysis framework. As we moved towards the end of the course all the information presented kind of 'clicked' together and I gained overall understanding of different topics regarding value chain analysis and how they are related. I realize now that sometimes you have to be patient when learning and take one step at a time."

In the self-assessment setting, the specification level of assessment criteria did not matter to the students' positive attitude and actions towards evaluation of their learning achievement and behaviours. The role of teacher and the type of instrument, however, determine the level of self-evaluation and institutionalization of the students' learning assessment. When teacher took the role of a listener and facilitator (not a judge), and when an opened, safe and trustful environment was created, the students were more motivated and critics to their self-learning assessment.

Relationships between assessment forms and students' skill developed

When looking at relationships between assessment forms and students' skill developed, I focused on what skills the students developed under what types of criteria and instrument used in different assessment forms as summarized in table 24.2.

Table 24.2 shows that types of assessment criteria and instrument closely connect to types of skill that the students developed. The students

Criteria and instrument	Assessment and learning skill
General criteria; unplanned instrument (i.e.: 1st and 2nd events in co-assessment)	• Non skill was observed. Only raising the students' awareness about learning assessment
Constructive criteria for improving GP performance; interactive peer-review (i.e.: 1st and 2nd events in peer-assessment)	• Framing the assessment criteria for having constructive comments • Asking for comments • Analysing the relevance of comments • Making decision on what are relevant and what are not • Formulating an effective feedback report with mentioning both good and weak points • Constructing clear messages in the comments • Effective communicating the comments to receivers • Developing ability to learn in the interactive teaching-leaning environment
General evaluative criteria for assessment of the students' learning; collective reflection (i.e.: 1st event in self-assessment)	• Reflecting on learning behaviour and attitude • Effective communicating and discussing messages in the self-reflection
General evaluative criteria for assessment of the students' learning; self-reflection (i.e.: 2nd event in self-assessment)	• Reflecting on own learning behaviour and attitude • Elaborating learning achievement • Analysing relationships between course structure, teaching-learning methods applied, students' activities and learning achievements and skill developed

Table 24.2. Types of criteria and instrument used and the students' skill developed.

developed more practical skills such as communication, questioning, and analysing skills when a set of constructive criteria for improving GP performance and interaction-oriented instrument was employed. Meanwhile, using general evaluative criteria to evaluate the learning achievement, the students developed more 'hard' skill that relates to the specific task of reflection of their own learning achievement. For achieving the course's learning outcomes, constructive criteria should be emphasized with the peer-assessment format.

24.1 Reflections and concluding remarks

In general, the students' OLA had changed from no ownership in the co-assessment, to collective ownership in the peer-assessment, and to self-motivation in the self-assessment. These changes are strongly influenced by specification level and orientation of assessment criteria as well as role of teacher and nature of the environment that was created for the assessment. Orientation of assessment criteria and nature of the feedback environment also shape the nature of skills developed by the students. For the students' achievement of learning outcomes in the course, the more constructive criteria for improving student activities' performance and results should be emphasized. Framing assessment then can use the principle of students' self-assessment for learning rather than the teachers' responsibility-oriented assessment of learning.

Reflecting my own observation and analysis throughout the experiment showed importance and necessary to transfer OLA from teacher to the students. This transfer can be done through framing the assessment section based on the constructive assessment (or learning-centred assessment and assessment for learning) principles (Desrosiers et al. 1997, Lopez-Pastor et al. 2013). With assessment for learning, students have opportunities to ask for and get feedbacks on issues that they think that are important for improving their learning. It can fit to dual purposes of: 1) increasing the students' motivation, mastery and autonomy as learners to develop their capacity to monitor and plan their own learning progress, and 2) improving student learning rather than summative grading and in the ownership of the learning where the student voice is heard in judging quality.

Part VI

Course structure analysis - constructive alignment

25

Using online quizzes for active learning and constructive alignment in a blended learning setting

Linda Udby

Niels Bohr Institute, University of Copenhagen

Introduction

In this project on university pedagogics I have experimented with very different types of online quizzes and investigated how they can be used to support different aspects of active and visible learning on a research-based master level course in Physics. The quizzes were not part of the formal assessment of the students but the students were nevertheless very engaged in the quizzes and in most cases felt they achieved deep learning of the topic by working with the quizzes.

Active learning

Approaches to learning can be divided into four categories (Entwhistle 2009).

- Surface passive (level of understanding = mentioning)
- Surface passive (level of understanding = describing)
- Deep passive (level of understanding = relating)
- Deep active (level of understanding = explaining)

Most students vary between these different approaches depending both on the type of teaching and the individual assignment but usually a deep active approach is desirable, especially in research-based teaching.

Active learning is a model of instruction that focus the responsibility of learning on learners and implements this by students working actively and directly with the material (Bonwell & Eison 1991). In pedagogical practice active learning is sometimes connected with the so-called flipped classroom where the teacher is more of a “guide on the side” than the “sage on the stage”. This is usually achieved by implementation of blended learning i.e. a combination of e-learning and class room learning. In a recent study of teaching within the disciplines of science, engineering and mathematics it has been proven that implementation of active learning reduces the percentage of failed students drastically as well as improve scores within science, engineering and mathematics (Freeman et al. 2014). In this project I will implement active learning by online quizzes used in a blended learning setting.

Central pedagogical concepts

In pedagogical constructivist theory learners use their own activity to construct their knowledge as interpreted through their own existing schemata (Biggs & Tang 2011). Three central concepts in pedagogics theory are teaching and learning activities (TLAs), intended learning objectives (ILOs) and assessment tasks (ATs). The ILOs specify not only what is to be learned but also how it is to be learned. In constructive alignment the TLAs adress the ILOs intrinsically and the ATs are aligned with the ILOs (Biggs & Tang 2011).

In terms of assessment two major types are distinguished: Formative feedback which is provided during learning, telling the students how well they are doing and what might need improvement. Summative assessment informs the students after learning how well they learnt what they were supposed to (Biggs & Tang 2011).

It is well established in pedagogics research that only formative feedback improves the learning outcomes for the students (Hattie & Timberley 2007).

What is a quiz

The Wikipedia definition of a quiz is as follows:

> *“A quiz is a form of game or mind sport in which the players (as individuals or in teams) attempt to answer questions correctly. In some countries, a quiz is also a brief assessment used in education and similar fields to measure growth in knowledge, abilities,*

and/or skills. Quizzes are usually scored in points and many quizzes are designed to determine a winner from a group of participants - usually the participant with the highest score."

Even though this definition is quite broad allowing quizzes to have a lot of different forms, the quizzes in focus in this project go even beyond the Wikipedia definition in that they are not necessarily brief and there are no scores in points or a winner being determined i.e. no summative feedback. The reason for making this choice in the quiz construction is explained well in the following quote:

> *"Quizzes can be developed in ways that they play less of an assessment role, and more of a teaching role. They assist learning by utilising teaching techniques that determine where students have their current understanding, and then taking them forward from that point"*(Quinn & Reid 2008)

One important pedagogical aspect of an online quiz is the possibility for the quiz constructor to implement immediate feedback based on previous replies or teachers experiences with pitfalls:

> *"The empirical result that possible misconceptions are few in number reflects the experience of most teachers that the student errors they encounter in tutorials, assignments and examinations are the same every year. It is rare for a student to come up with a wholly new way of getting it wrong. So if the forms of error are relatively few in number, why are they not documented so that we can address them in future teaching?"*(Laurillard 2002)

In the quizzes implemented in this project there are right, partially right and wrong answers and immediate feedback is implemented accordingly. The phrasing 'not correct' was avoided and phrasing such as 'we do not agree' was preferred in order to stress the formative nature of the assessment.

Online quiz tools

Surprisingly little seems to have been written about the use of online quizzes as a TLA, especially lacking is literature with specific focus on analysing the use of feedback quizzes and formative feedback. I did however find the discussion of various types of feedback quizzes based on analysis in Laurillards' conversational framework (Quinn & Reid 2008), as well as the chapter on feedback in (Rienecker & Bruun 2013) quite interesting for contextualisation of the present project.

In this project I have used the quiz modules of two separate learning management systems (LMS) to create the quizzes for my pedagogics experiments since they had different features:

Absalon is the LMS of University of Copenhagen which is produced by the company *It's learning*. It features a good guide to quiz construction but automated or adaptive immediate feedback on student replies is not possible.

Moodle is a very versatile open source LMS. It features immediate adaptive feedback on some quiz question types but the quiz modules are not very user-friendly and guides to quiz construction are mostly posted by users and scattered on the web.

The neutron scattering course

The quiz experiments in this project were implemented in a blended learning setting in the Neutron Scattering course. It is a project- and research-based course targeted for master-level students in Physics and Nano-science. The course has been running at the Niels Bohr Institute on a yearly basis since 2005. Each run features approximately 20 students, and the course runs for 8 weeks + 1 week hand-on experiments in Switzerland. Each week there is 12 hours class-time and the workload is nominally distributed as

Lectures	28
Practical exercises	56
Excursions	60
Preparation	62
Total	206

The practical exercises are distributed on written exercises ('regneøvelser'), simulation projects, and quizzes with the majority of hours on simulation projects. The course is formally assessed by pass/fail based on 3-4 reports, of which 2-3 are based on simulation projects and 1 on hands-on experiments. In 2014, 16 students started the course, 6 of which were foreign students. 14 students completed the course and they all passed the exam (reports).

Problem formulation

One of the challenges in research-based teaching in a 8-9 week course is to enable students to quickly familiarise with basic concepts and skills which they should use actively when learning about and participating in active research topics and activities.

In the neutron scattering course this means that the students have to read roughly 100 pages covering 6 chapters before the end of the second week of the course. As the course is also (simulation-)project based the students are furthermore required to get acquainted with the simulation software during the first weeks. We have noticed that students which lack behind at this point have a tendency not catch up later in the course which could hinder their deeper learning in the research-based and/or more complex part of the course. It is therefore important to motivate and engage the students to prepare for the first lecture by learning the contents of the first 28 pages before arriving at the first lecture (in order to remove this part of the workload during the next two weeks). This is the target of the first experimental quiz-type in this project.

It is equally important to engage the students in deep learning of the basic concepts of all 100 pages during the first two weeks of the course which is the target of the second experimental quiz-type in this project.

Another feature of the research-based nature of the course is that the lectures are given by 7 different lecturers, of which 5 are partaking specialised topics only in connection to their own research. This requires a high amount of coordination both in terms of curriculum in order to avoid overlaps and gaps, in terms of planning a natural flow of topics as well as a uniform level of constructive alignment. The risk of involving specialised guest-teachers is loss of coherence for the student learning, in particularly since each guest does not have the time-resources to participate in the daily/weekly planning and discussion of progress in the class. This could be mitigated by simple template framework allowing constructive alignment of each lecture/topic as well as for communication of learning goals between teachers and course responsibles and between teachers and students. This is the topic of the third experimental quiz-type of this project.

Defining clear learning objectives and corresponding learning activities which ensure deep learning is also essential when constructing individual modules in an e-learning course and this is a major pedagogical interest for me since I'm leading the construction of an e-learning platform: Virtual Neutrons for Teaching (Udby et al. n.d.). The portal is specialised for teaching and learning scattering techniques and we are currently constructing an introductory course in neutron scattering which will follow best principles from the classroom course at the Niels Bohr Institute including the experiments with quizzes in this project. The classroom will be used to test most of the online tools in a blended learning setting.

Method

In this project on university pedagogics I will investigate the potential impact of quizzes as active learning tools with formative assessment. I have introduced three very different quizzes in a blended learning setting at the Niels Bohr Institute with the purpose of

1. improving student preparation level
2. promoting student engagement level and deeper learning
3. enabling a framework for constructive alignment of a lesson

All quizzes implemented automatic online feedback on student replies and in addition feedback in class was given. The quizzes were mandatory but not part of the formal evaluation of the students, Student assessment in connection with quizzes was purely formative.

Finally data for evaluation of the effect of implementation of the three experimental quiz types was gathered in a focus group interview after the course ended.

Preparation quiz

I constructed a quiz designed to improve the preparation level of the students already from the first lesson. The students were given notice 5 days in advance of the first lesson with deadline just before the first lesson. The three parts were constructed in the quiz module of the Moodle LMS and separately targeted to

a) motivate the students to read the first two chapters of the course notes before even arriving at the first course day
b) give them warm-up calculation exercises while familiarising with some of the concepts and tools in the first two chapters of the course notes
c) engage them in deeper learning of those two chapters

Part a) consisted of a simple question 'What is neutron scattering used for?'. Student replies were in the format of multiple choice with several possible answers and with automated feedback on their replies as seen on Illustration 4 in Appendix A: Quiz questions and feedback.

Part b) consisted of 5 questions regarding 'neutron properties'. The students had to use tabulated conversion factors in the course notes as a tool in order to calculate the correct answers. Student replys were a mixture of multiple choice and numerical answers with automated feedback on their replies. The quiz questions and example feedback is shown on Illustration 5 in Appendix A : Quiz questions and feedback.

Part c) consisted in a single question 'What the differential cross-section of the sample?'. It requires the student to reflect on the central concept of chapter 2 but is not mathematically difficult. The question is of a conceptual nature since the students have to relate the information prior to the question to concepts in the notes and to find the formula which to use in order to calculate the differential cross-section. The quiz question and example feedback is shown in Illustration 6 in Appendix A : Quiz questions and feedback. The deadline for this part of the quiz was extended to the next day after the first lecture in order to see the effect of the lecture on the replies.

Reflection quiz

The reflection quiz was constructed by the students themselves in Absalon as a follow-up and reflection on Chapters 3 and 4 of the course notes at the end of the second week. The reason for this was to experiment with visible learning ("when teachers see learning through the eyes of students and help them become their own teachers")since according to (Hattie 2009) the biggest effect on student learning occurs when students become their own teachers (and teachers become learners) and most people learn 95% of what they teach someone else (Biggs & Tang 2011).

Preparations for quiz construction

The quiz design was performed in the last lecture of the second week. As preparation for the quiz-design lecture the students were asked in advance to read chapters 3+4 and reflect on

- which parts or specific expressions did you think were particular important? Pick at least one example that you haven't worked with actively in class (e.g. in exercises or quizzes).

- which parts or specific expressions did you have a hard time understanding?

In class I gave a ~20 min lecture about various formats of quiz questions and answering types in Absalon and which are suitable for what purpose. I used the information in the Absalon quiz help pages as the main source. Straight after the lecture the quiz was designed.

Quiz design
The design of the quiz question was done in class (using approximately 1 hour in total) from the following steps:

- Each student wrote 1-3 points they found important in the textbook but which they hadn't worked actively with in problem or simulation sessions. The points were written on separate oversized post-its and put on the whiteboard.
- Each student wrote 1-3 questions regarding the textbook contents. The points were written on separate oversized post-its and put on the whiteboard.
- The students then went to read the post-its and collect/group similar ones coached by the teacher who recorded the points/questions and coordinated overlap reduction.
- Each student formulated one quiz question from the ideas of the important or not understood points on the post-its.

The next step was that each student designed a question which should take at most 5 mins to answer, decided on the answer type and finally implemented it into a unified quiz template that I had prepared in advance in Absalon, deadline was the day after the lecture.

Quiz completion
Finally all the students should answer the full quiz. They were supposed to do it over the weekend but due to technical problems the deadline was extended by one week.

Constructive alignment quiz

The Learning Objectives (ILOs) of a particular lesson were made openly available to the students before the in-class lesson and formulated as quiz questions designed in Absalon. Since constructive alignment is a well-established pedagogics practice I chose to experiment with the motivation and autonomy of the students in the way that I let them decide how or if they would prepare for the lesson for instance by looking up keywords in the ILOs.

In class, the 4 ILOs were repeated as the first slide of the lecture and consecutively addressed in TLAs during the lecture by

- dialogue on learning goals 1-4
- ’summeøvelse’ in small groups connecting learning goals 3+4

The ATs consisted in the ILOs posed as questions which the students were asked to answer at the end of the lesson. All student replies were in the ’short open answer’ format.

Since it is not possible to give immediate automated formative feedback in Absalon the formative feedback was given as a plenum discussion in the following lecture.

Results

The students were only given formative feedback but the LMSs of course record their summative results in terms of grades which I will also include here for completeness of data and basis for discussion in section 4. The students were allowed an unlimited amount of attempts to take the quiz.

Preparation quiz results

The student participation and summative results in the preparation quiz are shown in Illustration 25.1. The quiz was constructed so that the student had to express how sure they were of each answer. If they were sure on a wrong answer or unsure of a right answer they were given a penalty.

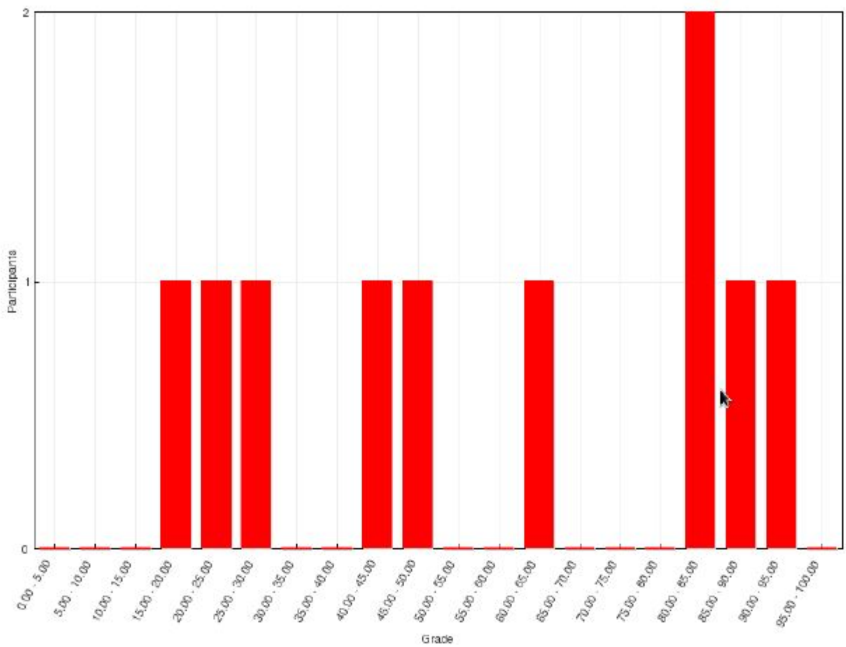


Fig. 25.1. Distribution of student grades in the preparation quiz after all attempts. One student obtained only a negative grade of -5 (due to penalties on 'sureness') which is not shown.

The participation and summative results in each part of the preparation quiz are summarised below

a) "What is neutron scattering used for ?", 19 attempts (11/15 students replied), average grade of first attempts 81%.
b) "Neutron properties", 22 attempts (11/15 students replied), average grade 26%, no 100% correct answers.
c) "The neutron differential cross-section", 31 attempts (11/15 students replied), only one correct answer before lesson. 9 students repeated the quiz attempt after the lecture 4 of which answered correctly at that point.

Reflection quiz results

The summative student results are shown in Illustration 25.2. In one of the quiz questions the ’correct answer’ as typed in by the student responsible for the particular quiz question was actually not correct, hence the student replies to this question should be neglected which would shift the distribution slightly to the right.

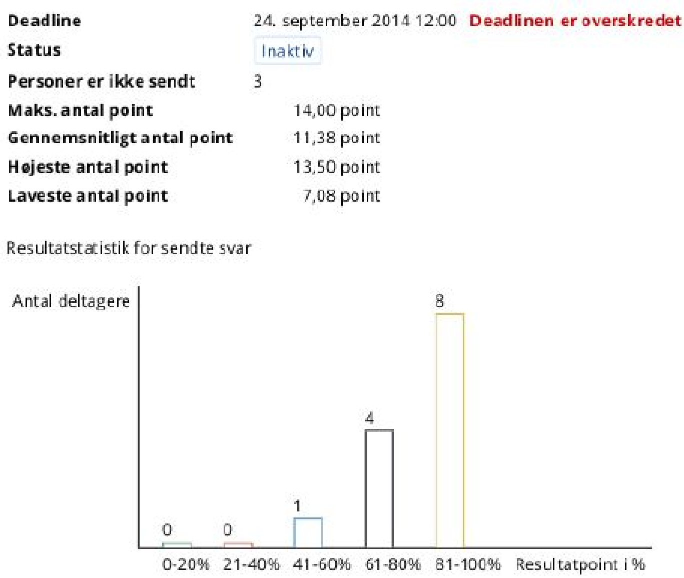


Fig. 25.2. Distribution of student grade in the reflection quiz. No students had less that 50% correct answers.

Constructive alignment quiz results

11 students made each one attempt at the quiz (4 students were not attending the lecture but one of them still attempted the quiz trying to guess the contents of the lecture). The summative results are shown in Illustration 25.3 below.

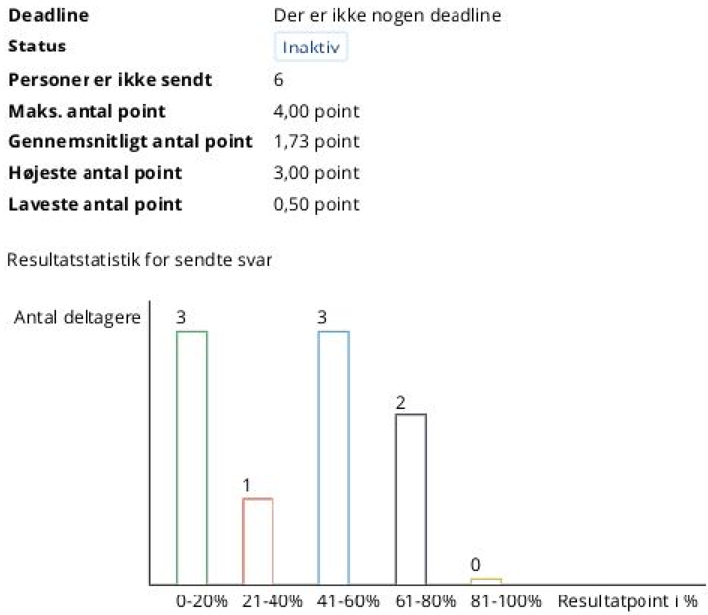


Fig. 25.3. Distribution of student grades in the ’constructive alignment’ quiz. It is seen that 1/3 of the participants had less than 21% correct responses.

Analysis/Discussion

In order to discuss the impact of the three quiz experiments I invited the students to a focus group interview a couple of weeks after the course ended offering them coffee and cake for their troubles. 9 out of 14 students showed up and a couple more wanted to come but were not able to. The interview was recorded on a dictaphone and I showed the explicit quizzes on my computer screen. The interview was structured as a discussion with some general open questions regarding the course in the beginning and end of the interview and more specific questions in the middle. In general I tried to steer the discussion from specific quotes rather than giving the full agenda directly. The full transcription of the interview is shown in Appendix B: Transcription of interview. In the analysis below I’ve selected specific points and quotes (both marked by [time]) from the interview in order to illustrate and discuss specific points in the problem formulation.

Improving student preparation level

The students in general seem to check the weeklies before arriving at the first lesson on a course and some will also read in advance given there is enough time after the weekly has been posted. [16:30-17:20]. Even though some did find the quiz motivating for reading the course notes others didn't seem to think they needed motivation to read the material although in practice they don't always actually read the material

> *[18:30] (E) most of the time I would anyway be motivated to read in advance in order to understand what's going on in class. But in this course I actually didn't do much reading ...*
> *[20:15] (K) I read all the material before even seeing the quizzes so they couldn't motivate me but if I know I have to answer questions I would find it motivational. But in general I always prefer to read beforehand, but life is not always turning out that way.*

Most of the students did the preparation quiz (with parts a-c) in advance of the first lecture and in general it made them work more deeply with the material as was intended

> *[17:25] ... [it made me work more deeply] because you have to understand what is written in order to solve the quizzes. Normally I would just read it through and be done but to do the quizzes you have to revisit the material sometimes.*
> *[18:00] ... it is a nice way to make sure you've understood the main parts of the chapters you've read.*

In terms of the types of quizzes they seemed to especially like the shorter ones that 'made them think' but it was also pointed out that the combination with 'warm-up' calculation exercises was good after the summer-holidays

> *[22:05] (D) I like the ones that make you think. (several) yeah...*
> *[22:15] (Z) I like the shorter questions without too much calculations because that's what exercises are for. Quizzes are better for checking whether I got the point.*
> *[22:35] (J) Yes I'm also thinking that if it's a long quiz that has a lot of questions you can just go and find the answer to type them in without a lot of reflection, but if it's a short question which makes you think then it's better.*
> *[23:00] (K) I think it's a good thing to have a combination like you*

had in the three quizzes…
(Z) Yes ...
(K)...but you could also merge them into one quiz where you have some thing which are conceptual and some things to calculate. It's good to have calculations as a warm up exercises, because maybe it's been a while since you had a theoretically based course and this is the first course after the summer holiday so maybe it's been a long time since you did calculations

It is interesting that the students did not perceive the preparation quiz as too hard even though the grades distribution (Illustration 25.1) was actually very flat with half the students achieving less than 50% even after several tries. Part of the reason for the low grades might however be unmatched expectations of the student to the level of correctness of his reply for which there was a penalty in this particular quiz. It was especially surprising that part c) which none of the students successfully solved before the lecture was not perceived as being too hard.

[26:30] (K) If I recall it correctly you had all the information you needed to plug into the equation, but the hard thing is to understand what is what in this text of informations. It was not too hard but I had to think about it a little and read the text and figure out what referred to which symbol and so on.

This perception might however be due to the time of the interview (after the course was successfully passed by all students and thus looking back they did not find contents hard to understand), or perhaps because the students were allowed to answer the question again after the lecture with more success.

Providing deep learning through reflection

My main concern about the design process of the reflection quiz was to which degree it should be anonymised between the students in order to conceal which parts of the text each student had a hard time understanding. It however turned out they did not feel uncomfortable putting their questions on a post-it on the whiteboard:

[27:55] (F) I didn't mind ... (several) no, that was fine
[28:10] (J) And we weren't saying particularly 'I didn't understand that' which could be embarrassing, we just put up this piece of paper. So it feels a bit anonymous (several agreeing).

The objective was to make the students feel responsible for reading the notes and work with them deeply even though there is a lot of material during that week of the course and the quiz seemed to achieve this goal

> *[28:50] (J) I remember that the question I had was particularly difficult and I don't know if I was the right person to answer that or making a question out of it because I wasn't sure of my understanding so maybe I looked in that part of the notes in more detail.*
> *[29:25] (A) But I think you have a bigger responsibility when you have to make the question...*
> *[33:08] (Z) If you are answering a question you are just searching for one particular information but if you are creating a question you need to first understand everything, then select something good and even double-check it makes sense.*

It was however entirely the responsibility of teaching the other students well and making sure they had a deep understanding themselves which motivated their work:

> *[34:20] (A) It is embarrassing to ask a question there is no answer to. It is more embarrassing to ask a bad question than give a bad answer. (several) yes, that's true!*
> *[34:48] (D) yes and if you teach something that is wrong, if your answers are wrong then there's a bigger responsibility to that.*

The element of competition in terms of voting for 'best quiz question' had no effect on their motivation and the fact that they were not graded seemed only to be a positive motivation:

> *[41:20] (several) yes, it was still motivating [to make the quiz even though we were not graded]*
> *[41:25] (Z) I think it was a very good thing that we were not graded... [41:40] (D/J?) Although I must confess that the total lack of pressure sometimes made me forget to finish the quiz...*

The students' own perception of deep learning through the reflection quiz is further supported by their summative results; as shown in Illustration 25.2 all students obtained more than 50% correct answers when taking the quiz.

A template for constructive alignment

The idea was to do constructive alignment for a single lecture in order to clarify the learning objectives both for teacher and students in a simple template format: A few clear intended learning objectives for a single lecture was defined and posted openly before the lecture in quiz question format, the TLAs during the lecture ('summeøvelse' and dialogue) were aligned to the ILOs and finally the ILOs were tested as a quiz in the end of the lecture. In order to see whether the students would be motivated to seek information on their own prior to the lecture from the keywords in the ILOs no homework was specified. This experiment did not turn out very successfully as the following conversation shows:

> *[47:50] (T) yeah we got these handouts (the 2 pdf pages previously referred to) so I looked that up, what we will do and so on but nothing really specific like going though the textbook*
> *[48:20] (F) I looked in the internet because I couldn't remember which instrument was what (Morpheus and RITA). But I didn't find out when looking at the internet I only found out on the trip.*
> *[48:35] (J) I remember having read something about the materials...*
> *[48.55] (F) I'm not sure which ones were the learning goals, were they the ones just on a regular Absalon page?*
> *[49:10] Yes, did you take a look at them before you came for the lecture?*
> *[49:15] (Several) No*
> *[49:25] In my lecture I showed you the learning goals as the first slide – do you remember that?*
> *[49:29] (several) yes ...*
> *[49:35] Did you try to keep it in mind during the lecture?*
> *[49:50] (several) I don't remember/ I wasn't at the lecture...*
> *[54:15] (D) yes but it was so short that it didn't stick in my mind, maybe I just over-listened it but it just seemed really brief to me*

Since the results of the constructive alignment quiz showed that many of the students did not achieve the ILOs I decided to do a follow-up lecture where the students were specifically told to go through the handouts and note down any questions they might have. The lecture was very dialogue-based. The students found that lecture particularly useful

> *[51:58] (T) But the lecture was useful though, the last one before going to PSI*
> *[52:00] (several) I agree with T...*
> *[53:00] (J) I did try to read the information sheets rapidly and during the lecture I tried to remember what I had read and I remember*

you asked us a lot of questions so the lecture was very interactive that way.

Conclusion and outlook

Overall the student participation in the quizzes was very high even though the quiz results were not part of the formal assessment and grading of the student, contrary to experiences in our University pedagogics pre-project which also implemented quizzes (Holst et al. 2014).

The first two experiments were very successful in achieving the objectives:

1. To help the students with deeper learning of bulk material as well as getting familiar with the tools and doing calculations already from the start of the course and to
2. keep that deep learning involvement in terms of reflection of the following chapters.

The students were very satisfied with the learning outcomes of making quizzes themselves (the reflection quiz) so much that they would like to do it in more topics but maybe in shorter formats and probably the correct answers should be checked by the teacher before the quiz is taken by the students. The high learning outcomes of this type of quiz is supported in the theory of visible learning (Hattie 2009) in which self-verbalisation/questioning is highly influential on the student achievement.

Another important influential factor on student achievement in visible learning theory is teacher clarity which was the focus in the constructive alignment template quiz. Surprisingly, this experiment was not a success with the students but it seems the failure was mostly due to (intentional by experiment) lack of specified homework. I do however think it was a success with me as a teacher in order to focus my lecture as well as plan TLAs and making the TLOs easily accessible to the other teachers in the course. I would like to try a similar experiment again next year with a little more guidance for the students towards where information for preparation of the lecture could be found. Furthermore the phrasing of the ILOs should be more specific in terms of how the students are supposed to achieve each ILO. A couple of examples could be 'describe the main physical characteristics of the samples' or maybe aim for a higher taxonomy level (Biggs &

Tang 2011) in e.g. 'compare/contrast what you will measure at the diffractometer Morpheus and the triple-axis spectrometer RITA-II'.

One obvious point for improvement in all quizzes which many of the students wanted is to make sure the students are able answer each question separately several times if they fail the first attempt instead of having to take the full quiz again. This functionality did not work in the version of Moodle which was used for the preparation quiz and in Absalon the feature is not implemented at all. A new version of Moodle has been made available after the completion of the experiments in this project and hopefully the repeated single answer functionality will work with an upgrade to this version.

Acknowledgements

I thank my departmental supervisor Kim Lefmann (NBI) and pedagogical supervisor Lars Ulriksen (IND) for feedback on the report, Jesper Bruun (IND) for good discussions on the project and providing references for the report. I also thank the students of the Neutron Scattering course 2014 for participation in this pedagogical experiment and in the focus group interview.

A Quiz questions and feedback

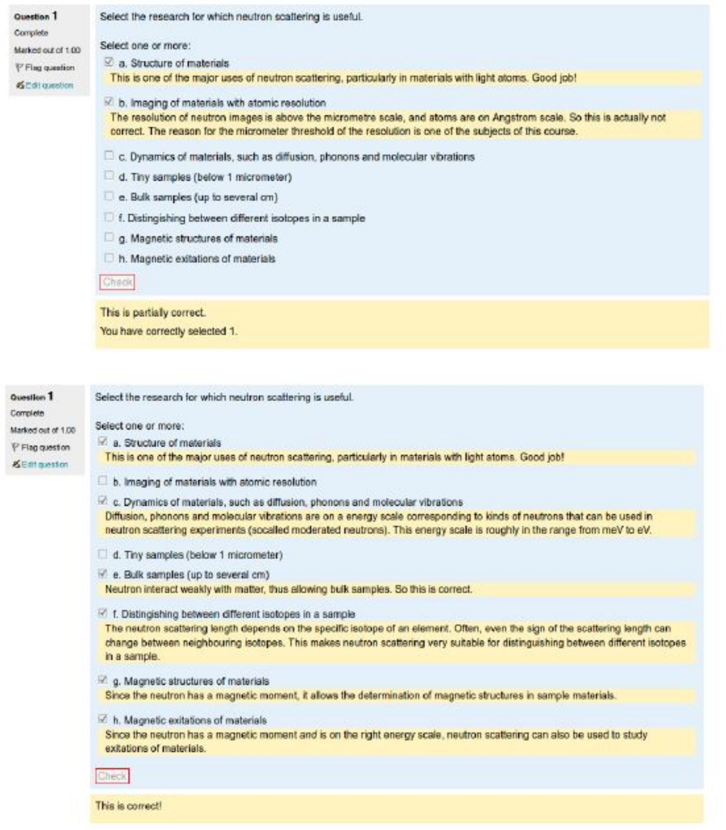


Illustration 4: Part a) of the preparation quiz showing various feedback reply formats after pressing the 'check' button.

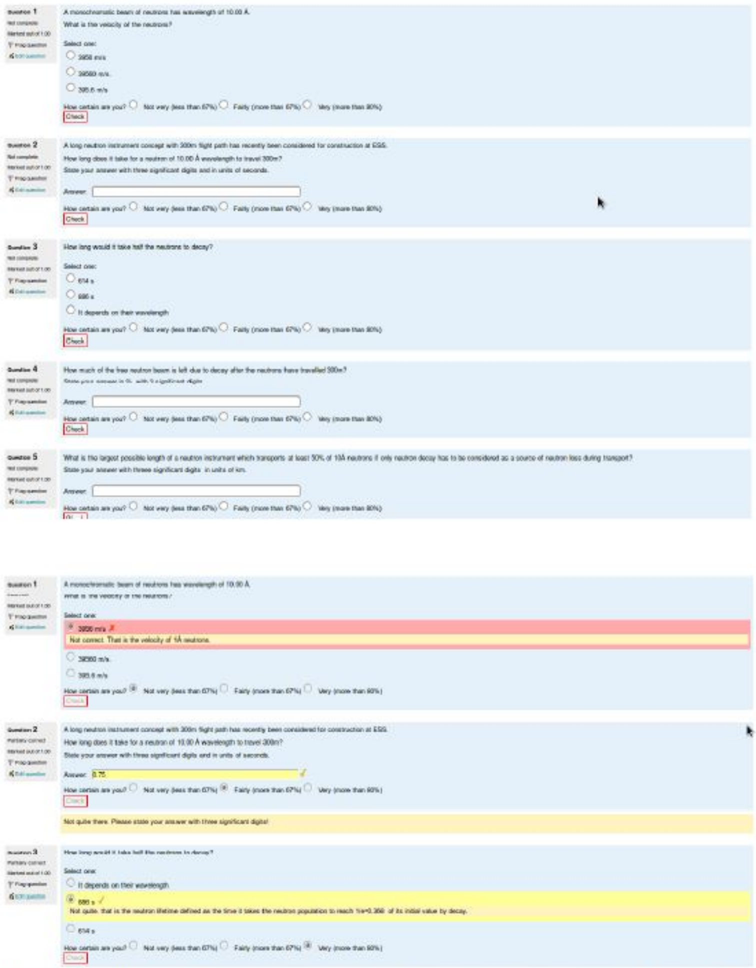


Illustration 5: Part b) of the preparation quiz. The top figure shows all 5 questions in the quiz, the bottom figure shows example response to wrong answers of the three first questions.

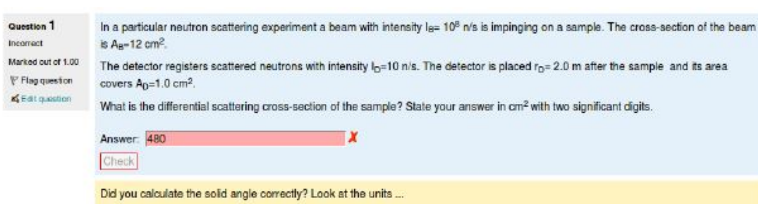


Illustration 6: Part c) of the preparation quiz including feedback to a wrong answer.

B Transcrption of interview

Transcription of focus group interview. In some places the quotes have been shortened and wording slightly changed for comprehensibility. 9 students participated and they have been anonymised here. Emphasised quotes are the interviewer (Linda Udby).

[0:10] In which ways has this course been different than other courses
[0:17] (A) All kind of ways
[0:20] (K)The trip to PSI, to visit another institute to see what they do in real life
[1:00] (Z) the simulations were great, the fact that we were simulating the same thing as in the experiments was very helpful
[1:10] (J) I must say there was a huge effort on your part so that we really learned, it was a very complete course due to the variation of the activities. In my home university I've never been in a course were we received so much attention, there were always several people making sure that we were learning and I found that absolutely outstanding.
[2:00] Which kind of activities are you referring to?
[2:04] (J) When I registered for this course I was nervous about the schedule, since I'm not used to classes that last all day long. And I was worried that it would be boring doing the same topic en entire day. But it ended up being the total opposite due to the variation of teaching methods during class, lectures, simulations and quizzes. So I ended up really enjoying it and it was not a burden at all to be here all day long (almost everyone agrees)
[2:54] (JN?) sometimes it can be too varied so each subtopic is too brief. This was especially the case for crystallography, I don't think I will recognize a lot from that part in a year, but I'm not exactly sure why. Maybe I would have preferred a smaller curriculum in that part and then having more activities and going into depth with that part.
[4:00] (Z) For me it was actually interesting to see many different topics as long as I'm not specialising in any of them. The only thing I would change in the lectures is to skip the mathematics derivations in the lectures since I don't get anything out of calculations if I don't do them myself. I would prefer them to be on the website instead.
[4:50] (F) I agree, we didn't learn from the calculations that Kim went though which we didn't do ourselves or get to use in practice. That was a waste of time.
[5:20] (K) Kim is actually one of the better lecturers to go through the calculations though in order to make them have sense for the students.
[5:40] (Z) I'm not saying it doesn't make sense to do them but I would prefer to talk about Physics concepts in class instead.
[5:45]You said that you prefer some things to be on the web-page, did you use the WIKI for example?
[5:50] [All nod] We used a mixture between web-page and printed notes.
[6:30] I think the curriculum is OK. One of the things that are different in this course though is the many lecturers and I actually felt happy when it was Linda or Kim giving a lecture because it is difficult to adjust to learning from a lot of different people. And the teachers sometimes have no clue what the other teachers have thought or who we are so both parts waste a lot of time trying to communicate and get to know each other. That has been the only frustrating thing for me in this course.
I know it is a privilege to have the researchers tell us what they do but the course is too short to have so many different lecturers. I would take out a few of them and make sure that the rest were more aware of the red line through the course and the position.
[8:55] Is that a general impression? (about half nod)
[9:00] (Z) For me it actually wasn't like that, I didn't feel that there was a big overlap, and I actually enjoyed a different point of view on the same topic.

[9:22] (A) I had the same feeling (as K)
[9:26] (F?) yeah me too
[9:39] (A) I don't think many of the lectures should be skipped but I missed to have a familiar person here all the time.
[9:50] (K) I think one of the course responsibles should always be present
[10:15] How did you work with the quizzes?
[10:20] (F) In general as you know the feedback didn't work properly but I think it will be a lot better when it does.
[10:40] Did you work alone or in groups with the quizzes?
[10:45] (several) mostly alone
[10:55](A,JN) we did it mostly in groups
[11:00] (T) we tried to do it alone and then if we didn't understand it we could collaborate
[11:10] (J) I think most of them were very well structured except for the one in crystallography ... (?) yeah it was ... (J) that was a waste of time as I think our result showed.
[11:20] Did you try to do any of them home alone or was it always in class?
[11:25] (F) I did some at home
[11:30](Z) If I couldn't be in class the I did some of them at home
[11:50] How did you work with the quizzes? Did you think about it or look it up
[11:55] (E) I couldn't remember all the answers sometimes I had to go back and look in the material
[12:00](D?) I looked everywhere, even google [laughter]
[12:11] (K) It is very nice that you have the WIKI pages right next to the quizzes in the browser, especially when you sit in class and maybe don't have so much space. It is also easier to search in the WIKI text than in the printed notes.
[12:50] (F) I mostly used the notes because sometimes the math typesetting in the WIKI was too slow, but it might just be my Linux system. (?) What? (D?) mine was also slow but my computer is also tiny. (K) there was no problems on my MAC.
[13:40] Do you think that it is in general easier to search for a particular concept when you are solving a quiz in the WIKI page than in the notes (most agree)
[14:00] (Z) I think it is nice but I'm used to just work with any material I have including my own notes.
[14:20] (D?) I find it quite useful. I don't like reading a lot on the computer screen but when you just have to search for something it is really useful.
[14:30] I think is was really useful that you also had access to the simulation projects on the WIKI, that was another tool which should be used for solving the quizzes. I used the Wiki a lot.

[15:00] I would like to ask you some specific questions about the quizzes. So in order to refresh you memories I will just show you which ones I'm talking about
[15:19] (K) I've memorised all of them ha ha ...
[15:30] For the first week you did three different quizzes as preparation. The first quiz was just a short one asking you what neutron scattering can be used for, the second one was longer and you had to do calculations,and the third one was a single question but a little more complex in terms of understanding the answer. (showing each quiz as they are explained). Did you actually do the quizzes as preparation?
[16:20] (most people nodding or saying yes)
[16:25] So how so you normally prepare for the first lesson of a course lesson?
[16:30] (Z) I check the weeklies
[16:40] (K) ... but sometimes they are only uploaded the day before, and then there is too little time to prepare.
[17:20] Did the quizzes make you prepare differently than what you normally do?
[17:25] (J?)yes it did because you have to understand what is written in order to solve the quizzes.

Normally I would just read it through and be done but to do the quizzes you have to revisit the materiel sometimes.
[17:45] How about the rest of you, did you also prepare more deeply than what you would normally do?
[18:00] (A) yes, it is a nice way to make sure you've understood the main parts of the chapters you've read.
[18:10] Did you find the quizzes motivating for you to read beforehand?
[18:15] (K) yes, otherwise you couldn't answer the quizzes
[18:20] Did it actually help you get started or was it just another thing you had to do before turning up for class?
[18:30] (E) most of the time I would anyway be motivated to read in advance in order to understand what's going on in class. But in this course I actually didn't do much reading ... sorry!
[19:05] Don't be sorry I'm glad you are honest about it.
[19: 30] Can you tell me what you liked or disliked about the short versus long quizzes?
[19:48] (several) It's a very long time ago ...
[19:55] The first one was very general - what can you use neutron scattering for.
[19:58] (several) that one was fine ...
[20:00] But did it help you to read the notes or did you just browse for the answer?
[20:08] (F) Well you browse but then you also read to make sure you understand it
[20:15] (K) I read all the material before even seeing the quizzes so they couldn't motivate me but if I know I have to answer questions I would find it motivational. But in general I always prefer to read beforehand, but life is not always turning out that way.
[21:16] How about the rest of you how do you prefer to prepare?
[21:10] (about half) No ... (about half) yes
[21:30] (E) I read the notes beforehand and when I do the quiz I then go back to the point
[21:40] Do you have any preference to the length of the quiz? The single question ones versus the longer ones including calculations?
[22:05] (D) I like the ones that make you think. (several) yeah ...
[22:15] (Z) I like the shorter questions without too much calculations because that's what exercises are for. Quizzes are better for checking the whether I got the point.
[22:35] (J) Yes I'm also thinking that if it's a long quiz that has a lot of questions you can just go and find the answer to type them in without a lot of reflection, but if it's a short question that makes you think the it's better.
[23:00] (K) I think it's a good thing to have a combination like you had in the three quizzes (Z, yes) but you could also merge them into one quiz where you have some thing which are conceptual and some things to calculate. It's good to have calculations as a warm up exercises, because maybe it's been a while since you had a theoretically based course and this is the first course after the summer holiday so maybe it's been a long time since you did calculations, so it's maybe a good thing to force yourself to get in the 'zone' again before you sit there with everyone in class and you risk that things go over your head.
[23:46] Did you feel that any of these quizzes was a warm up exercises and which one?
[24:10] (K) yes the ones where you had to calculate length of the guide and use table 1.1. It's a useful way to get familiar with the tools of the course.
[24:29] Is this kind of warm-up useful to some other of you?
[24:30] (several) yes, yeah
[24:35] You said that the useful quizzes are the ones that make you think. Do you remember if any of these quizzes made you think?
[24:40] (F) Something with the flux
[24:48] The one about the differential cross-section?
[24:52] (F) yes that one because I didn't know what that was before I read the quiz so I spend a very

long time on it because it was a very small section of the notes.
[25:10] Did you read the full chapter 2 or just that section?
[25:15] (F) I read what I was supposed to read but I don't know which part it was in. I think you shouldn't be afraid to give more material – I would like that.
[25:35] (K) I also think that one was good because you learned to translate what was in the notes from something theoretical to something experimental related.
[26:00] Do you think this particular question which is quite conceptual was too hard to have before the lesson?
[26:20] (F) No that was fine ...
[26:30] (K) If I recall it correctly you had all the information you needed to plug into the equation, but the hard thing is to understand what is what in this text of informations. It was not too hard but I had to think about a little and read the text and figure out what referred to which symbol and so on.

[27:10] The next quiz I'd like to discuss is the reflection quiz that you did yourselves – do you rember that one? (explaining the process in class and showing the quiz on the computer-screen, and people nodding familiarly).
[27:50] How did you feel about posing your questions openly in class?
[27:55] (F) I didn't mind ... (several) no, that was fine
[28:10] (J) And we weren't saying particularly 'I didn't understand that' which could be embarrassing, we just put up this piece of paper. So it feels a bit anonymous (several agreeing)
[28:35] Did you work differently with the chapters 3 & 4 which you used as a basis for the reflection quiz?
[28:50] (J) I remember that the question I had was particularly difficult and I don't know if I was the right person to answer that or making a question out of it because I wasn't sure of my understanding so maybe I looked in that part of the notes in more detail.
[28:05] Did you pick your own question?
[29:10] (J) No I picked someone else's question
[29:15] What made you pick this question?
[29:20] (J) I think it was the last one left, ha ha
[29:25] (A) But I think you have a bigger responsibility when you have to make the question ...
[29:30] (J) Yes of course that made me work with that part of the notes in greater detail
[29:40] (F) I took the one with least amount of work in it because we got in on one day and had to submit it next day and since I had to work that evening I was quite stressed about it. So I had pick a short one, maybe if you give one more day or something ...
[30:25] (T?) yeah I didn't know how to formulate the question or to make it a good one so I just ended up making an easy one that I don't think helped anybody at all because it was just so easy
[30:38] (A) I felt the same ...
[30:40] So it sounds like formulating the question was a bit difficult?
[30:50] (Z) Yes but it was so useful because the I spend more time making the question than I else would have so I think that asking questions on our own is very useful for understanding.
[31:00] I made a walk-through of the different possibilities for answer-types you have in Absalon. Was that helpful or did you already know this in advance?
[31:20] (Z) Yes it was helpful
[31:25] (J) I didn't know there were so many different ways that allows you to be creative in your formulation of the question
[31:50] (Z) yes but I don't like long answers because I'm not sure if anybody are reading them., I would rather like to put in a number and check whether it is correct. From my point of view formulating the long answers are stressful to formulate and not so useful.
[32:30] Do you think that it is a general thing that you work deeper or differently with the topic when formulating questions on your own?

[32:35] (several nodding or saying yeah)
[32:44] What did you do that was different when making your question?
[33:00] (J) You feel that you fully have to understand it and therefore go deeper into it. (several 'yeah')
[33:08] (Z) If you are answering a question you are just searching for one particular information but if you are creating a question you need to first understand everything, then select something good and even double-check it makes sense.
[33:37] How about the voting on the best quiz questions? Was that motivating?
[33:44] (several) No, not at all
[34:00] What was then motivating for you?
[34:20] (A) It is embarrassing to ask a question there is no answer to. It is more embarrassing to ask a bad question than give a bad answer. (several) yes, that true1
[34:30] So do you feel responsible for the other students?
[34:40] (A) yes because then I spend their time
[34:48] (D) yes and if you teach something that is wrong, if your answers are wrong then there's a bigger responsibility to that
[35:00] Do you think it would be a good idea to make this kind of reflection quiz in more topics during the course?
[35:04] Mmmh (several nodding)
[35:10] (F?) But then you should keep it short, so that we didn't have to solve questions from all the students because some of the questions took a long time. Especially if you have to answer it twice ...
[35:50] Oh yes there was a technical issue so you had to type it in again ...
[35:55] (F) yes and I didn't write my answers down
[36:13] (J) you should also make sure there are no wrong answers in the quiz before you send it out
[36:30](F) I also had a problem to insert an equation, it though it was a virus so maybe you could check that ...
[36:55] How long did you use to solve the quiz?
[37:00] (F) Between one or two hours I think
[37:10] When you posed your questions did you think about that it should not take more than 5 mins to answer?
[37:13] (D) yes but when there is 17 it takes 1-2 hours to answer
[37:15] there were just 14 ...
[37:23] (F) OK but some took more than 5 mins to answer
[37:25] (?) but some also less, maybe like 20 sek...
[37:40] (A) But I think the main problem is what J said, first you have to spend one hour to make the question, then another on doing the quiz, then another hour in class on feedback so we end up spending a lot of time on it.
[37:50] Was the walk-though useful at all?
[37:55] (A) I don't think so ... That's a general thing about the quiz walk-throughs I think we spend too much. I prefer if 2-3 questions with a general trend in wrong answers are taken out and walked through.
[38:28] (F) I agree
[38:30] (J)Yeah I agree, I got the feeling that some of the questions we walked through were answered correctly by almost everyone. Of course I couldn't see the answers but I though like 'most people can answer this question'
[39:00] Well as you say you didn't see the answers ...
[39:05](laughter)
[39:10] ... but it is definitely a good point
[39:20] (Z)I was surprised that there was no time limit in the quizzes, it could be important to know whether we could solve a simple question in three minutes or twenty minutes. Maybe that's way to

make it shorter and more effective.
[39:50] (T) I wouldn't put a time limit (several) No...
[40:00] (D) It makes it really stressful you cannot concentrate at all
[40:10] (Z) I agree with that in relation to exercises, it was very nice that we could you as much time as we wanted but when we are talking simple questions i would put a time limit just to make it shorter
[40:40] (D) that was one of the great thing about the quizzes, that there was no grading, no timelimit,no stress at all ...
[40:45] (Z) But I felt stress with the quizzes (several laughing), if it was over after one hour I wouldn't have to think more about it ...
[41:15] So you think it was worthwhile doing the quizzes even though you would not be graded?
[41:20] (several) yes, it was still motivating
[41:25] (Z) I think it was a very good thing that we were not graded ...
[41:40] (D/J?) Although I must confess that the total lack of pressure sometimes made me forget to finish the quiz ...
[41:50] Was it motivational for you if I sent out a reminder?
[41:55] (several) yes of course ...
[42:00] (D/J?) yes but sometimes I just forgot about it, it was not because i didn't want to do it. Maybe there should be a due date, three days should be more than enough
[42:35] (Z) But I would prefer to have deadlines related to our schedule, maybe the day before the lecture ...
[42:55] Do you prefer to have the deadlines before or after the weekend?
[43:00] (a few) after the weekend ...
[43:10] (F) It depends on the simulation projects. If you put the deadline on the same day I wouldn't do the quiz but just the project so you should put some time in between.
[43:25] So you would in general do the mandatory things for the course first?
[43:30] Yes if then I didn't finish the simulation project I would just continue working on that and never get to the quiz.

[43:50] OK, then talking about quizzes with timelimit, there was actually one quiz with a time limit and that was the last one (showing). This one had something to do with the learning goals. Do you remember that? (they don't seem to remember). Just before we went to PSI I was giving a lecture and in that lecture there were some learning goals
[44:22] (several) Ah yeah ...
[44:27] You might not have thought of it as a quiz but it actually was
[44.29] (several) Oh ! On Absalon... we had like 10 mins after the lecture to finish it
[45:15] I posted the learning goals on Absalon before giving the lecture and these learning goals also figured in the beginning of the lecture and then in the end they were posted as a quiz that you had to answer before leaving class. I would like to ask you how you prepared for this lecture?
[45:48] (F) I'm not sure I found the material for preparation ... Well we had these 2-3 pdf pages that we had available prior to the lecture but if you posted something else I didn't see it. so I only read those and I didn't quite understand them because they were too short to understand for a person not knowing anything about RITA and Morpheus ...
[46:20] (T) I read those two things as well ...
[46:28] Did you recognise any keywords in the formulation of the learning goals?
[46:45] (Z) Hmm .. try again?
[46:50] OK, I'll try to read them aloud. The first one was 'what is the characteristics of the samples you will study at PSI?'. And the second is 'what has previously been find' ...
My question is whether you recognised any keywords in those learning goals that you actually looked up in advance in order to prepare for the lecture.

[47:20] (F) Recognise keyword compared to what? Compared to the articles?
[47:30] Some words in the learning goals that you might recognise or maybe want to look up?
[47:40] (D) Like 'What is a triple axis spectrometer' ?
[47:44] Yes did you look that up for example?
[47:50] (T) yeah we got these handouts (the 2 pdf pages previously referred to) so I looked that up, what we will do and so on but nothing really specific like going though the textbook
[48:20] (F) I looked in the internet because I couldn't remember which instrument was what (Morpheus and RITA). But I didn't find out when looking at the internet I only found out on the trip.
[48:35] (J) I remember having read something about the materials...
[48.55] (F) I'm not sure which ones were the learning goals, were they the ones just on a regular Absalon page?
[49:10] Yes, did you take a look at them before you came for the lecture?
[49:15] (Several) No
[49:25] in my lecture I showed you the learning goals as the first slide – do you remember that?
[49:29] (several) yes ...
[49:35] Did you try to keep it in mind during the lecture?
[49:50] (several) I don't remember/ I wasn't at the lecture ...
[50.00] (F) I think I didn't know much about the experiments so in the lecture I had a hard time relating to that stuff. Maybe we hadn't started the RITA simulations at that point?
[50:30] I was trying to just understand what we would do at PSI at all, because I couldn't distinguish between what we would do at RITA and Morpheus. So the goals for me were not clear at all...
[51:10] During the lecture or?
[51:20] (D) Well I got the basic idea but I wouldn't be able to do the experiment, it wasn't clear
[51:31] (E) well the goals in the material was not so clear
[51:35] (D) It wasn't helpful to me at all these handouts. I got to see how the sample was connect, I could imagine that, but that was all
[51:45] (A) Before I went to PSI I couldn't understand the handouts at all, but then the second day down there when we started and I read it again a lot of stuff made sense. But I don't know if it is possible to give you a feeling in advance of what it will be like ...
[51:58] (T) But the lecture was useful though, the last one before going to PSI
[52:00] (several) I agree with T ..
[52:10] So having a dialogue about the handouts was useful?
[52:23] (several) yeah ...
[52:35] (D) I do think it is important to make an introduction before you go to PSI though even if it doesn't answer all your questions
[53:50] Did you feel that you worked actively with you own knowledge during the lecture?
[53:00] (J) I did try to read the information sheets rapidly and during the lecture I tried to remember what I had read and I remember you asked us a lot of questions so the lecture was very interactive that way.
[53:30] (D) For me personally it would very quick, there was doping and this and that ... I would like to start more slowly and the accelerate
[53:40] Are you talking about the first or second lecture?
[53:42] (D) The second lecture where you introduced RITA and Morpheus, and then we would measure doping and magnetic structure ...
[54:10] In the first lecture we talked about what we were going to use RITA and Morpheus for, do you remember that?
[54:15] (D) yes but it was so short that it didn't stick in my mind, maybe I just over-listened it but it just seemed really brief to me
[54:25] Do the rest of you feel the same way?
[54:30] (?) I don't remember ...

[54:40] (T?) When I went to PSI I knew which experiments we would do at least that was clear
[54:50] (J) I think what happened was that my simulation group was lacking a bit behind in the end so all other thing were a bit too quick.
[55:15] (Z) yes it would be very nice if we could first finish all the other work first and the just focus on what we were going to do at PSI.
[55:45] (T?)Yes if felt a bit rushed in the end ...
[56:00] is that a general thing that you would like to spend more time talking about PSI?
[56:03] (D)Yes it was too short to become clear
[56:06] (Z) It's hard to say because I cannot not imagine that it is possible to really understand it before you see it.
[56:30] (A) I think in general we were well prepared to pick up stuff quickly at PSI
(several) Mmmh. (A) You can only understand it up to a certain point before but for the last understanding you have to be there.
[56:50] What do you think has prepared you well to go there?
[57:00] (several) the simulations. (Z) And also the theory of course, but the simulation when you came there it was just like 'ah now I get it'. Mostly the creation of the simulations, writing the reports was not so crucial for me. (several Mmmh). I would have liked more preparation for processing the data though. I'm not so used to working with Matlab and I had to learn it at PSI so we could have saved the time by preparing in advance.
[57:55] Do you think you could be just as well prepared not writing a report but just playing around with the simulations?
[58:00] (Z) Yes
[58:15] (T) Well I still think there should be some analysis of what we have done. Not that you got the angle or intensities right, but that you really understand what you got, to interpret it. But writing the text, putting the theory etc. I think it's useful but not so much.
[58:54] (Z) well I think if we can answer the questions it could absolutely be enough for me without the reports
[59:00] So would a discussion in class be adequate?
[59:05] (Z) The fact that we wrote the code it makes it quite clear whether we know what we're doing
[59:20] (A) I would keep the first report and disregard the second report. But we should have a discussion about the third report to come to a conclusion.
[59.40] (D) yes the third simulation project was really important for PSI
[59:45] (A).... so if we skipped the second one then maybe we could start earlier on the third project
[1:00:10] (Z) About the the second I think we had very little feedback, I was expecting something that had to do with the understanding but it was just more formal things like not whether there should be space between the number and unit but more like if we could have made more efficient simulation.
[1:01:00] (K) I would maybe leave out the IMRAD method for the reports because you spend a lot of time when you're asked to make a nice report because you don't want to hand in a nice report so you spend a lot of time on making things look nice in LaTeX which I don't learn anything than LaTeX from.
I know how important it is that you can read the labels in scientific papers and stuff like that but I think that maybe that can be left for the last report. I would have learned just as much Physics from just answering the questions. Like handling in a sheet of paper with just 'question number' and the showing the graph from McStas and commenting and making the calculations that are needed to move on. Making comments like 'we see a peak here what does that mean?'. That would put more focus on the Physics part and not so much on the formalism and discussing with your group whether a particular part should go in the discussion, the conclusion or maybe actually in the method ... that's useful if you have to publish a paper, but not for this.

26

Constructive alignment analysis and redesign of the Ph.D. course ’Innovation and intellectual property rights in biotechnology’

Anders Bach

Department of Drug Design and Pharmacology, University of Copenhagen

Outline

1. Introduction
2. What is constructive alignment?
3. Description of the course in the current ’LIFE’ version
4. Redesign and adjustments of the course into its new ’HEALTH’ version
5. Conclusion and Discussion

1. Introduction:

In this report, I will analyse the Ph.D. course ’Innovation and intellectual property rights in biotechnology’. From next year, this course will be offered by HEALTH instead of LIFE due to the faculty merge, and thus it is expected to attract students with a stronger focus on drug discovery and human health than previously. I will focus on the technical contents of the course and the alignment between intended learning outcomes, learning activities, and assessment. Potential adjustments will be suggested with the aim of facilitating its transition to become a HEALTH course, and to increase the student’s learning outcome.

2. What is constructive alignment?

Constructive alignment (CA) is about how to structure and design teaching in order to facilitate deep learning. Some of its fundamental principles are that clear and stated goals (Intended learning outcomes) induce efficient learning; that learning depends on what the students actively do to obtain it; and that the format and requirements of the exam direct the students´ efforts and behaviour and thus their final learning outcome. According to the original Biggs' CA model from 1999, the following three main elements must match and support each other, i.e. be aligned, in order for the students to engage in deep learning (Rienecker et al. 2013, pp.97-98; Andersen 2010, pp.134):

a Intended learning outcome (The competences we wish to give the students)
b Teaching and learning activities (The format of the teaching, e.g. lectures/classes/exercises)
c Assessment (How it is being measured that the intended learning outcomes are achieved)

For example, if it is a goal (intended learning outcome) that the students should become able to use bioinformatics and patent data bases to evaluate the 'freedom-to-operate' situation of a potential invention, the course is badly aligned if this competence is not being practiced during the course (but perhaps only theoretically described). So, to obtain alignment, intended learning outcome and teaching/learning activities must correlate and support each other. Likewise, if the final exam does not reflect what has been taught or practiced (e.g. demonstrate the use of databases to solve tasks versus only demonstrating their awareness of these databases), or reflect the expected learning outcome, the course is misaligned.

But why is CA important? Although not everyone agrees that focusing on CA is beneficial (e.g. some raises the argument that a rigid focus on CA simplifies university pedagogy and lead to a narrow-minded and technocratic mentality, (Andersen 2010)the supporters point out that CA:

- Assures that student-activities that aid the intended learning are applied (Rienecker et al. 2013, pp.97; Andersen 2010)
- Assures that the final exam/assessment is designed in a way that guides the students' efforts in the desired way. E.g. if deep understanding and analytical skills are required for passing the exam this is known by the students and thus incite them to obtain these competences (Rienecker et al. 2013, pp.98; Andersen 2010).

- Guides the students, leading to less frustration and disappointment and more ‘fairness’ in the assessment. The students ’know’ which competences are required for the final exam (Grønbæk & Winsløw 2003).
- Provides a useful tool for the teacher when preparing. If goals (intended learning objectives) are clear, it is easier to prepare and adjust the teaching accordingly (Grønbæk & Winsløw 2003).
- Provides a tool for dissecting a course into its essential elements, which is useful when analysing and (re)evaluating/designing courses (Grønbæk & Winsløw 2003).

The principles of CA have now been integrated in Danish education law (Rienecker et al. 2013, pp.134), and e.g. the goals of each course must be described. Formally, teaching goals must be expressed by the ‘skills’, ‘knowledge’ and ‘competences’ acquired by the students (Rienecker et al. 2013, pp.134). Without engaging in a semantic discussion of these terms (but see (Rienecker et al. 2013, pp.134-140) if interested), it is a general trend in modern university pedagogy that goals are described by ‘competences’, where competences are skills and knowledge that can be combined, integrated and applied in a practical and professional situation (Andersen 2010, Grønbæk & Winsløw 2003). Also, the competences can be adapted and thus used in other perhaps more advanced situations later on. Thus, in its essence, phrasing competences is about describing what exactly the students will become capable of doing in a professional setting or at their following level of education. Clearly, the goals (or intended learning objectives) are so fundamental in CA, as they affect teaching activities, assessment, and thereby the final learning outcome. Therefore, it is essential to phrase the goals in a manner that facilitates high quality. There is a vast amount of literature and guidelines how to do that (Rienecker et al. 2013, pp.133-145; Grønbæk & Winsløw 2003; Bowden 2004) but generally the trend is to describe competences using the behavioural verbs from the SOLO taxonomy (Rienecker et al. 2013, pp.101-102, 141; Appendix A), which relates to an increasing level and complexity of learning and competences. If used correctly and precisely, this should lead to meaningful, clear and operational goals, which guide both teachers and students in their work. Also, in line with this, Bowden suggests that a useful approach is to first ask, which competences are requested in working life, and then ascertain that the final exam assesses these competences. Then goals and teaching activities form naturally thereafter (Bowden 2004).

CA is relevant at several levels. CA should be considered within each individual course (as discussed above); but also, within each individual teaching ’event’ (lecture/lesson/exercise) it is relevant to think about if intended learning outcomes align with the activities, and if assessment is sufficiently implemented to support learning (Rienecker et al. 2013, pp.147). Finally, CA is relevant at the ’external’ level, meaning that each course should be aligned with the study plan of the education, so it is clear how the specific courses contribute to the competence goals of the education.

3. Description of the course in the current ’LIFE’ version

General info:
The course has been hosted for 5 years by the Dep. of Plant and Environmental Sciences at the Faculty of LIFE (now part of SCIENCE), University of Copenhagen. It is a 1-week course (4 ECTS) aimed at PhD students as well as scientists from industry (26 participants in 2013). Prof. Peter Ulvskov has established the course and served as course leader. The teachers are university researchers with entrepreneurial experience from both Sweden and Denmark, experts in IPR (intellectual property rights), entrepreneurs, research directors from biotech, Tech Trans experts, and venture capitalists. In 2013, 18 different teachers taught the course. Course home page is: http://www.dias.kvl.dk/iprforphds.html. Below is found a description of key elements of the course:

Technical contents: When analyzing the 2013 scheme (Appendix B), it is seen that the number of exercises (incl. round table discussions) were 10, and the number of lectures (incl. demonstrations) were 22; and that each day comprised both kinds of teaching. The subjects being covered in the lectures and exercises can be divided into categories revealing the main themes of the course:

- IPR (in general): 4 lectures and 6 exercises
- (small molecules): 3 lectures and 1 exercise
- IPR (genetics): 1 lecture and 1 exercise
- Business plans and addressing investors: 3 lectures and 2 exercises
- Market potential/analysis: 3 lectures
- Entrepreneurial case studies: 3 lectures
- Biotech (as a business): 2 lectures

- Various: 3 lectures (Stem cells in biotech, Innovation management, BBIP master program)

The material for the course comprise a text book (Patenting in Biotechnology, a laboratory manual) by Peter Ulvskov, and documents that must be read before course (4 'R' document), browsed before course and then read during course (4 'B' documents), or printed to the exercises (8 'P' documents).

Intended learning outcomes:
From the course description ('målbeskrivelsen')[1] it is seen that the *overall aims* of the course are: "to stimulate integration of patenting and innovation in the research laboratories and enable the course participants to tap into the knowledgebase that patents represent"
...and:
"to endow the participants with concrete skills in finding patents and patent applications, recognizing relevant document types and judging the strength of the patents or applications on the basis of an understanding of the patenting process."

More specifically, it is stated that students who met the objectives of the course will be able to:

1. Make participants familiar with the steps required in developing biotechnological products e.g. new drugs
2. Provide knowledge about defining and identifying a commercially interesting problem
3. Enable the participants in navigating the patent landscape surrounding the product
4. Introduction to business plans and raising venture capital for the new company

Teaching and learning activities: The course comprise a series of lectures and parallel case studies. Patenting and use of patent literature and databases are taught in computer exercises. Case studies of business plans and the founding of new biotech companies will be supplemented with discussions with invited entrepreneurs.

---

[1] Currently the project description cannot be found at the course home page as the course is being redesigned. The course description has instead been acquired from Prof. Peter Ulvskov (personal communication).

Assessment:

At the last course day there will be a 1.5 hour written exam. Aids are pen and hand-written notes.

Course evaluations:

Evaluations from 2013 were very positive. The students were asked to grade each lecture and exercise from 0-3 (where 3 is best) with respect to relevance, quality, and time allocated. Generally, the allocated time for the exercises was sufficient (only minor adjustments are necessary), and the average grade was 2.6 and 2.5 with respect to relevance and quality, respectively.

4. Redesign and adjustments of the course into its new 'HEALTH' version

Technical contents:

Overall, I believe that the course covers important IPR-related topics of common relevance to students no matter their institutional background, such as obviousness, novelty, freedom-to-operate analysis, institutions involved, how to read, file and pursue patents, and how to search in patent literature using databases. Also, market analysis, business plans and strategies for addressing investors and establishing capital are of general relevance. Thus, these topics constitute the core of the course and should remain.

Because the course from now on will be offered by HEALTH, and more specifically by the 'Drug research Academy (DRA)' Ph.D. school (located at Dep. of Drug Design and Pharmacology) future students most likely anticipate a certain focus or bias towards drug discovery and medical aspects of patenting. Also, it is the course leaders´ wish that the content reflects the background of the students and teachers, and the institution that is hosting the course. However, as the course already covers specific drug discovery related examples (e.g. small molecules and genetics) only a few adjustments are found necessary as proposed here:

1. Introduce a lecture and exercise that covers the subjects of 'Biopharmaceuticals', which is a growing field and highly relevant for the stu-

dents at HEATLH. - It has now been arranged that a person from Novo Nordisk will give a talk where he describes the challenges of patenting peptides/proteins (and derivatives thereof) as drugs.
2. The subject of patent mitigation could/should be covered by a person from industry working with small molecules (e.g. Lundbeck), as in previous years of the course.
3. The 'meet an entrepreneur' lesson should be held by a person with a closer relationship to HEATLH (e.g. an internal) so that students better can relate to the entrepreneur and the circumstances of which he managed to start-up a biotech company.

Also, a suggestion is to group the course into 'themes' so the main subjects of the course become very clear. This could be done with headlines on the scheme, and by covering one theme per day

Intended learning outcomes:
DRA (the institution that will now host the course) only has some very general visions and goals (http://dra.ku.dk/about/vision) and no specific intended learning objectives. But still, from these and general knowledge of DRA it is obvious that the current course offers competences highly relevant for the students enrolled at DRA (and likely also for other Ph.D. schools within the areas of medical sciences and biotechnology), so the 'external CA' seems to be fine.

The overall aims of the course as phrased now ("*... stimulate integration of patenting and innovation in the research ... enable the course participants to tap into the knowledgebase that patents represent... concrete skills in finding patents and patent applications, recognizing relevant document types and judging the strength of the patents or applications...*") are in my view accurate and covers the key aspects of the course. Subsequently, they must be substantiated by concrete and precise intended learning objectives that describe the specific competences possible to obtain. Thus, in appendix 3, I propose a new set of intended learning objectives based on behavioural verbs from the SOLO taxonomy in an attempt to make the goals more clear and operational (i.e. so that both students and teachers know what to do to achieve the goals). The goals as such are covered by the current as well as adjusted course format and content, but perhaps these phrasings provide more concrete and practical goals that also reflect an increasing level of learning complexity. Also, I have asked myself which competences are needed if/when you want to become a biotech-entrepreneur cf.

(Bowden 2004), and incorporated these skill sets into the goals starting with the most fundamental ones.

Teaching and learning activities:
The course already mixes different teaching styles (lessons, computer exercises, round table discussions), and I believe these support the intended learning objectives. For example, the use of computer-exercises for practicing the use and enhancing the knowledge of patent databases is an essential element of the course, as it provides the students with concrete skills that are practical applicable and relevant for their future work.

Assessment:
The current written exam is a practical and efficient assessment method; and, based on last year's exam questions, allows examination in a wide range of subjects. The exam questions first assess competences from the medium complexity level (identify, combine, describe; cf. SOLO taxonomy), but in order to get full points more complex competences (e.g. analyze, compare, reflect) must be applied. However, in order to better assess if the desired competences of using patent databases, analyzing freedom-to-operate situations, and perform market analyses have been acquired (Appendix 3, point c-e) the exam could include the use of patent databases and/or internet. Thereby the exam would mimic the 'real' professional situation, and assess on skill sets relevant and important in future work situations cf. (Bowden 2004). In line with this, the exam could also be replaced with a case-oriented assignment or presentation (potentially in groups) where such aspects of the course are covered. However, it must be considered if such a format would compromise the 1-week duration of the course, or could require extensive homework by the students.

5. Conclusion and Discussion

The course 'Innovation and intellectual property rights in biotechnology' has been analyzed with respect to its contents and CA; especially considering that the course will be provided by HEALTH (and DRA) instead of LIFE in the future, and thereby that a certain focus on drug discovery and medical science aspects of patenting and biotech is expected and desired.

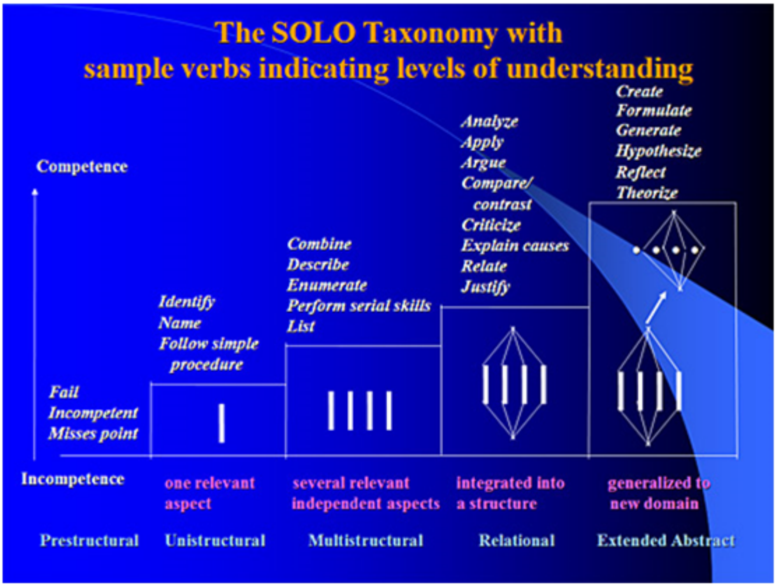
In its contents, the course was found to already cover general relevant and key aspects of patenting and biotechnology, and also to contain the appropriate drug discovery examples (e.g. small molecules). Therefore, only minor modifications, such as including the topic of biopharmaceuticals and adjusting the 'meet an entrepreneur' session, was found necessary.

It was found that the course in its 'LIFE format' was generally well-aligned; but that a few adjustments could strengthen the CA even further:

First, a new set of intended learning objectives were proposed (Appendix C) in an attempt to clarify the goals, make the acquired competences more practical applicable, and emphasize their relevance to 'real' working situations. However, this expanded goal description might appear too technocratic or dull in some people´s ear, why it might be necessary to simplify or modify the text in order to ascertain that the course still seem exciting and relevant for the students.

Secondly, it is considered if the assessment format could be changed into a more practical relevant exam or a case-oriented assignment/presentation. This would mimic the real-life situation more closely, and could assess both concrete competences of importance (e.g. use of patent databases) and their ability to analyse (e.g. patent and business situations). If such an assessment will be implemented it is important to emphasize this early at the course, so that the examination form can affect the behaviour of the students in the desired way.

A The SOLO taxonomy



B Scheme for 'Innovation and intellectual property rights in biotechnology' in 2013

Monday January 28	
9.00 - 9.30	Presentation of the course Peter Ulvskov
9.30-10.45	The Shrinking State of Biotech Ecosystem and New Organizational Forms Serden Ozcan
11.00 - 12.00	Introduction to intellectual property rights Peter Horn Møller
13.00 - 13.45	Patentability 1 Peter Horn Møller
14.00 - 15.00	Exercise: Search strategies, profiles and boolean algebra Peter Ulvskov, Bodil Jørgensen
15.15 - 16.00	"Refining the Biotech Model" The Future & How to Get There Øystein Rist
16.00 - 16.30	Introduction of market analysis, NABC, and assignment of homework. Hand-out Morten Heide
Tuesday January 29	
9.00 - 10.00	Exercise: Reading a patent 1, and homework assignment for Reading a patent 2 Peter Ulvskov
10.00 - 10.15	Group planning of Patent reading class 2
10.15 - 11.00	Small-molecules in drug discovery - real life examples John Nielsen
11.15 - 11.45	Protecting low molecular weight compounds Peter Horn Møller
12.45 - 13.30	Demonstration: Searching patents based on chemical structure using SciFinder Christian Skotte
13.30 - 14.30	Exercise: Searching patents based on chemical structure using SciFinder. John Nielsen and Christian Skotte
14.45 - 15.30	Businessplan groupwork at the library Morten Heide
15.30 - 16.30	Business plan, a roundtable discussion based on groupwork Morten Heide
Wednesday January 30	
9.00- 9.45	The patent system and its institutions: EPO, USPTO, PCT and the main differences between Europe and USA Peter Horn Møller
9.45 - 10.45	Patentability 2 with particular emphasis on biotech innovations (patenting of genes...) Peter Horn Møller
11.00-11.45	Mirrx and learnings from litigation Thorleif Møller
12.30 - 13.15	The life of a patent: submission strategies Peter Horn Møller
13.15 - 14.15	Exercise: Patent searching in Derwent 2, produce a hierarchical search profile Bodil Jørgensen and Peter Ulvskov
14.30 - 15.00	Meet an entrepreneur Morten Buch-Pedersen
15.00 - 15.30	Exercise: Patents search based on genetic sequence Peter Ulvskov and Bodil Jørgensen
15.30 - 16.15	Stem cells and the European Biotech Directive. Timo Minssen
16.15 - 16.45	Group work on patent reading class

Thursday January 31	
9.00 - 10.15	Exercise: Using Patent Register, patent families and All Documents. Produce a patent family tree. Peter Ulvskov and Bodil Jørgensen
10.15 - 11.15	Market analysis - a practical approach. Maria Andersson
11.25 - 12.00	Market evaluation using the NABC approach and mitigating the risks. Maria Andersson
13.00 - 14.00	Collodial Resources Karin Bryskhe
14.15 - 15.00	Exam discussion - questions and answers Peter Ulvskov and Peter Horn Møller
15.10 - 16.30	Exercise: Patent reading class 2 Peter Ulvskov
Friday February 1	
9.00 - 10.00	From Innovative to innovation: Know your customers and prepare them. Perspectives from the pharmaceutical industry Lars Brøchner
10.00 - 10.35	The High Technology Foundation Thomas Bjerre
10.45 - 11.15	PUFA a case study in radical innovation management Anders Grauslund
11.15 - 12.00	The entrepreneurial support ecosystem Peter Conrad Ottesen
13.00 - 13.45	Zealand Pharma and the BBIP master program David Solomon
13.45 - 14.15	Discussion and course evaluation Peter Ulvskov
14.30 - 16.00	Written exam

C Proposed intended learning objectives for 'Innovation and intellectual property rights in biotechnology':

A student who has met the objectives of the course will be able to:

A) Describe and explain the composition of patents within drug discovery and biotechnology, the rationale behind the different sections, and recognise the different types of patents. This includes: structural claims of small molecules and sequences (DNA/Protein); how to patent cells (e.g. stem cells), methods and technologies (e.g. assays); and 'use patents'.

B) Explain the different stages of the patenting process, and requirements for obtaining a patent.

C) Use the various databases to find the relevant patents and patent applications; and to recognize the different document types covering a given invention.

D) To be able to assess the strength and freedom-to-operate situation of a patent based on the obtained understanding and knowledge of patents, the patenting process, and databases.

E) Analyze and discuss the commercial potential of biotechnological ideas and inventions based on the technology platform, IP situation, and market analyses.

F) Describe and compare the different means to fund or finance inventions in order to commercialize these.

27

Implementation and evaluation of longer (> 3 hours) collaborative and case-based interactive learning exercises

Anton Stahl Olafsson

Department of Geosciences and Natural Resource Management, University of Copenhagen

Introduction

This assignment focus on constructive alignment and the inverted classroom approach.

In constructive aligned teaching the focus is on maximum consistency between intended learning outcomes (ILOs), teaching learning activities (TLAs) and the assessment tasks. The focus is on how students are to learn, rather than on what topics the teacher is to teach, hence, ILOs specifies not only what is to be learned, the topic, but how it is to be learned (Biggs & Tang 2011). Bloom's Taxonomy (from knowledge → comprehension → application → analysis → synthesis → evaluation) and skills in the cognitive domain of Bloom (remember → understand → apply → analyse → evaluate → create) is often applied in constructive aligned teaching.

Inverting the classroom (Bates & Galloway 2012, Lage et al. 2000), or the 'flipped classroom approach' (Butt 2013), means that events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa. Hence, the delivery of material (to remember and understand) is moved outside the class room and the formal class time is used to undertake collaborative and interactive activities relevant to that material. The use of multimedia and Internet is often integrated in the inverted class room approaches to support the delivery of material (e.g. by recorded lectures etc.).

This project will not apply a full inverted or flipped class room approach, which foremost has been applied to introduction and basic courses

(Bates & Galloway 2012, Lage et al. 2000). The project takes its departure in an interdisciplinary 7.5 ECTS master course which include app. 12 guest-lectures from different disciplines and also from practice (for a short presentation of the master course see table 27.1). Hence, the traditional lecture approach remains the main teaching-learning activity, but collaborative and interactive activities will be tested as a weekly activity inspired by experiences from the flipped class room approaches.

Project objectives

This project will seek to develop, test, and evaluate longer (> 3 hours) collaborative and case-based interactive learning exercises. The following hypotheses will be tested based on students' oral evaluation comments:

Hypothesis 1: The introduction of the exercises will enhance deep learning.

Hypothesis 2: The introduction of the exercises will improve constructive alignment

Methodology

In the following, the new exercises will be described followed by a short description of how the material (in the form of student feedback) was collected to support this study.

Description of the new exercises

The objective of the exercises was to improve constructive alignment in the course. Hence, in line with constructivist theory of learning, students were to use their own activity to construct their knowledge (Biggs & Tang 2011), and at the same time the exercises should improve alignment of the ILOs with the summative assessment (i.e. the final synopsis exam where students are supposed to apply analytical frameworks to a self-selected case). An additionally objective was to provide the teacher with continuous feedback from the students concerning level of understanding and comprehension thereby giving the teacher improved insight into the learning process.

ILOs	TLAs	Summative assessment
The course has two overall goals: 1. to make the students aware of their personal biases in relation to landscape values; 2. and to enable them to identify, analyze and compare the meanings of nature of different stakeholders in order to generate appropriate solutions to problems and/or conflicts in the countryside. Knowledge: Present examples of different theories and methodologies for analyzing meanings of nature and describe and compare their content. Skills: Ability to select and use methods and theories for analyses and comparison of nature perception in concrete cases. Competences: Ability to present and discuss similarities and differences of nature perception based on theories and empery	24 lectures (½ guest lectures) Teacher provided reading list (to be read before class) Most lectures included short plenum and group discussions Excursions (1½ day) Student presentations	Synopsis exam (written + oral) Hand in of a short individual written synopsis on self-selected topic (max 13,000 character) Oral power-point presentation of synopsis Oral discussion with examiner and external examiner.

Table 27.1. Short presentation of the Nature Perception course with focus on constructive alignment. The course is offered to students from the master programmes of: Nature Management (as a semi-compulsory course), Landscape Architecture and Agronomy. This year 10 students from DK and 22 students from other countries (SP, BU, NL, FI, IC, US, UK, CAN, and AUS) were enrolled. The students hold different bachelor degrees (e.g. from Biology, Geography, Landscape Architecture, Environmental Science, Agronomy, Naturel Resource Management, Forestry Engineering). The 7.5 ECTS point course is running in block 2 (final exam dates 20th, 21th, and 22th of January 2014).

The exercises can be characterized as collaborative case-based TLAs. Following the argumentation by Krogh et al. (2013), case-based teaching improve the students' structure of their knowledge, increase their communicative competences, and enhance their ability to apply a holistic approach integrating both theory and practice. All these competences are important parts of the individual final summative synopsis exam.

The exercises were made up of the following components:

- Case-based learning
- Problem-based learning
- Collaborative-based learning (group work)
- Group presentation and peer/teacher-assessment

In total three exercises were developed targeting three different case-based problems (attitudes to emptying a lake/river restoration; visitor management in a protected DK area; and red deer management in UK). The exercise objectives were clearly presented by the teacher together with course ILOs and the idea behind the final summative assessment. It was explained that the exercises were introduced at the course in order to prepare for the final individual summative assessment.

The exercises were based on collaborative learning. Groups were constituted by the teacher (3-5 students in each group) with emphasis on different compositions of students each time. The groups had 2-4 hours to conduct the analyses and prepare a power point presentation of their findings. The exercises differed by type of empery. The first exercise was based on material provided by an external guest lecture, the second exercise were based on excerpts from interviews made available by the teacher, while the third exercise was based on the students own material produced by help of world wide web searches. The exercises focused on identification of differences in key stakeholders' nature perception by the use of different analytical/theoretical frameworks in each exercise.

The exercises followed the three phases in case-based teaching as described by Krogh et al. (2013): In phase 1, students worked individually with the provided material (15-25 minutes), followed by phase 2 with collaborative group discussions and preparation of the findings (2-3 hours), and finally, phase 3 were made up of a case seminar with group power point presentations of findings and feedback from peer-students (peer assessment) and the teacher (10-15 minutes/group, 1 hour in total).

Evaluation of exercises

An oral evaluation followed each exercise providing data for this assignment. Student feedback was collected as a series of statements and comments by the teacher.

The overall course evaluation was made up of an oral evaluation and a written evaluation. The outcome of the written evaluation was not available at the time of writing, but the oral comments from the course evaluation will be included. In the oral evaluation the students were asked to write down one negative and one positive comment about the course on two post-it notes. The notes were thereby grouped based on similarity on the black board, and the outcome was discussed in plenum with the students (see figure 27.1).

Fig. 27.1. Grouping of student feedback on black board.

Results

First, the evaluation comments based on the three exercises will be presented, and then, the course evaluation comments will be presented with an emphasis on the objectives of this assignment.

The student oral evaluation comments based on the three exercises were both positive and negative. In table 27.2 the positive comments are grouped according to "improvement of constructive alignment", "links between case-based teaching and deeper learning" and "benefits of collaborative learning". The negative comments were either focused on the "form" (process of the exercise) or the "content" (the case or subject) of the exercises.

Many positive comments were made (and a lot of nodding) to the usefulness of the exercise in terms of learning, e.g., "*when I use it [the frameworks] it becomes clearer*". Particular the collaborative set-up of the exercises were highlighted as a contributor to deep learning. The discussions with peers seems to support "*deeper understanding*" and to be "*beneficial for understanding*", and finally, making the frameworks less theoretical. In terms of constructive alignment, the exercises seemed to complement lec-

Positive comments			**Negative comments**	
Improvement of constructive alignment	*Links between case-based teaching and learning*	*Benefits of collaborative learning*	*Form*	*Content*
"Fixing the concepts to the lectures" "I got a better overview of the frameworks"	"Very useful, until now we have learned a lot of superficial stuff (i.e: theories, concepts foremost based on lectures)" "When I use it [the frameworks] it becomes clearer" "We are in need for more practical inputs, i.e. less theory and more practice examples" "We are in need for grasping, need for cases"	"The discussions in the group was beneficial for understanding" "It's interesting to work in groups, it enables you to obtain a deeper understanding" "Beneficial and good with the discussions in the groups – the frameworks become less theoretical"	"Two hours [of group discussion] too much" [disagreement between students] "Set up a debate, a discussion between groups" "We need more critical feedback from the teacher" "We could have had more out of it – if we had read the other groups' interviews [case material]"	"The frameworks were too similar – when you had decided on one framework the others were easy to fit in" "Too much focus on animals – what about e.g. a land use type instead?"

Table 27.2. Selected exercise evaluation comments by the students.

tures by providing "*a better overview of frameworks*" and by "*fixing the concepts to the lectures*".

The negative comments were rather constructive, meaning that they did not question the presence of the exercises, but instead were focused on improving the form and the content of the exercises. Comments were made about the difficulties of being opponents to the other student groups' presentations (i.e. peer assessment), because of poor student preparation: "*We could have had more out of it – if we had read the other interviews*". The interview material had been provided before class on Absalon, but the peer assessment part of the exercises had not been stressed clear enough from the teacher (or the students didn't prioritize this). Hence, this part of the exercise should be improved next year. The teacher role in the assessment of the presentations was also criticized by expressing a need of more critical teacher feedback. Naturally, this will be improved next year due to more teacher experience of how students will approach and solve the different cases. This also points to another challenge of this class being that many of the students comes with a clear science background, and this is the first social science oriented course where they are approached by exercises with no clear answers in terms of correct and wrong – but with emphasis on poor and strong argumentation and documentation. A discussion was initiated on this with the students, but this turned out to be a balance act, since it seemed like some students were left with an impression that ‘everything goes’. An alternative form of the peer assessment was suggested by a student, with emphases on a form of panel discussion: “*Set up a debate, a discussion between groups*”. Other students commented that this approach might put more emphasis on the arguments instead of the frameworks.

The severity (difficulty level) was also commented as being low, i.e., too much time for group discussions and too easy (to apply the frameworks). But these comments were not agreed upon among all students, pointing to the teaching challenge of setting the most appropriate difficulty level.

The final oral course evaluation also produced interesting material of student perception of the long exercises compare to the other course TLAs. Many students focused on collaborative and case-based teaching activities including the long exercises in their final positive evaluation comments (11/27). Other positive comments were highlighting the relevance of the course (7), the guest lectures (3), the summative assessment form (2), the lectures (2), and the excursions (2).

Four negative evaluation comments also embraced exercises (and case and group-work in general) by stressing simply that the course did not include enough of this form of TLA, other negative comments were centered on a big and difficult curriculum (5), the lack of link between science, practice and conflict management (4), too long teaching days (2), the lectures (2), the guest lectures (2), and excursion (1).

These positive and negative highlights of the different TLAs were all interesting. Not only in terms of the number of similar comments, e.g. the high number of students expressing a need for more case-based exercises and collaborative discussions, but also in terms of importance of applying different TLAs in a course in order to comply with students different learning styles. This will be discussed in more details below.

Discussion and conclusions

The objective of this study was to improve deep learning and constructive alignment by including three new long collaborative and case-based exercises. Based on the students oral evaluation comments the exercises seemed to be successful in terms of learning, i.e. the students expressed an increased understanding of the subject. In terms of constructive alignment, it can be argued that this course used to be foremost based on traditional lectures and guest lectures (although many lectures incorporate small short 5-20 minutes collaborative or plenum discussion exercises). Hence, following Blooms revised taxonomy (Biggs & Tang 2011) it can be argued that the dominating TLA used to support ILOs of *remembering and understanding*, although the course ILOs were mostly focused on appropriate selection and use (that is *applying*) different frameworks (see table 27.1). The new long collaborative and case-based exercises were introduced to improve constructive alignment by putting more emphasis on *application* and *analysis*, followed by *synthesis* and *evaluation*. Some of the student comments support that this was actually the case (some students expressed an improved overview and improved understanding of lectures based on the exercises). However, at the time of writing the course is not completed. Hence, it will be interesting to see if the increased understanding will affect the outcome of the final summative assessment. Further, it will be interesting to see how the exercises will be evaluated in the final written overall course evaluation.

Finally, it is relevant to remember that not all students are collaborative and cooperative learners, e.g. some learn best via lecturing others can be characterized as experiential learners with emphasis on conducting experiments, or by self-directed studies for the independent learners (Lage et al. 2000). Hence, it is essential to apply a variety of teaching methods in class to comply with students' different learning styles (Lage et al. 2000). Based on this assumption, a full flipped class room approach with full focus on collaborative and case-based discussion exercises will not be applied in this course. Lecturing will still be an important part of the teaching methods, but alternative teaching activities will be tested in the coming years (e.g. peer-assessment, peer-supervision, and implementation of IT and interactive flipped class room activities outside class hours) and the lectures will be improved to be more in line with the course ILO. This will include transformation of one-way lectures to interactive conversations focused on e.g. similarities and differences of frameworks; by applying student reviews of lectures in the end; and to make sure that as many as possible student activities are incorporated in the lecture.

Part VII

Students’ perceptions of teaching environment and implications for teaching

28

Intended Learning outcome and course descriptions from a student's point of view – How are they perceived by the students?

Christoph Crocoll

Department of Plant and Environmental Sciences, University of Copenhagen

Introduction and project description

Constructive alignment is an important tool to ensure and maintain high quality teaching and to facilitate student learning. One major task to achieve constructive alignment is to align the **Intended Learning Outcome (ILO)** with Teaching-Learning-Activities and the assessment to evaluate if the ILOs have been achieved.

It is therefore of great importance that course descriptions meet the requirements for constructive alignment. This includes a detailed description of the course content and the ILOs. Especially ILOs stated in the course description can function as guidelines and help students to find suitable courses for their study program. It can also help them to find courses that meet the student's interests and help them to develop a portfolio of knowledge and techniques that might be valuable for their future career. The most obvious function of ILOs is of course the immediate description of what exactly they are going to learn or what knowledge students can expect to acquire during the course. Nevertheless, one has to keep in mind that there might be differences between mandatory courses and courses that can be freely chosen by the students. This might also depend on how advanced students are in their study program.

Therefore, it is of high importance to evaluate if ILOs are actually helpful for students and how students perceive ILOs and constructive alignment. The student's point of view is of high importance to evaluate the current state of constructive alignment and facilitate further development of constructive alignment.

The project

Many course descriptions at University of Copenhagen (KU) are already updated to meet the requirements for constructive alignment. The guidelines for course descriptions at KU require the statement of clear ILOs in three different fields: *Knowledge, Skills and Competences*. Though many course descriptions meet the requirements students might not be aware of their existence or how to make use of the ILOs for their learning success. This project should therefore give some insight into how students perceive course descriptions and ILOs and if they are of help to them. Some of the questions are based on the *Learning Experience Inventory* described in (Biggs & Tang 2011, pp. 285-286). Three major questions were used as guidelines:

1. How are ILOs in course descriptions perceived by students?
2. Are ILOs of help to the students to choose courses?
3. Do clear ILOs in a given course description help students to achieve these?

Two courses have been chosen for this to reflect upon the current state of course descriptions and might give rise to potential improvements for the future. The courses differed in a few points as one was a mandatory course in the Bachelor program for 3^{rd} year students in Biology-Biotechnology while the other course targets students in a range of Master programs: Food science, Food Technology, Human Nutrition and Gastronomy & Health (mandatory not in all study programs).

Methods

The courses

1. A BSc course "Experimental Molecular Biology". Course participants were asked to fill in questionnaires after the first half of the course (9 weeks, 39 participants, 35 questionnaires) which finishes with a written exam as assessment and at the end of the course (18 weeks, 23 questionnaires).
2. A MSc course on "Bioactive components and Human Health". Students were asked to fill in the questionnaires after the third lecture of the course (24 participants).

Questionnaires

Questionnaires were prepared to evaluate the student's awareness about course descriptions and ILOs in general and how helpful they consider them in general and for the specific course. In addition, the questionnaire for the Bachelor course contained a second part focusing on the student's self-evaluation based on the ILOs found in the course description. They were asked if and to which degree they already have achieved the ILOs stated in the course description. Here, thirteen ILOs from all three areas (*Knowledge, Skills and Competences*) were chosen. The last part of the questionnaire focused on the question if the students have learned what was described in the ILOs. The second part of the questionnaire was handed out to the students again after the second half of the course to evaluate if there had been changes in the student's learning outcome. Do ILOs help students to choose a specific course? Do they achieve the intended learning outcome? How are the ILOs perceived? This course provided a high complexity in ILOs and overall structure as it goes over two blocks. Questionnaires were handed out to the BSc students after the first nine weeks and at the end of the course. MSc students were asked to fill in the questionnaire after the first three lectures of the course.

Results

Course descriptions are considered helpful and read by most students

In general, students are aware of course descriptions and know how to access them. Nevertheless, there was a higher percentage of Master students (MSc) reading them compared to Bachelor students (BSc) with 95% and 68%, respectively. The number for Bachelor students increases to 84% if the neither/nor answer is taken into account. The students were also overall quite happy with the quality of the course description (66% and 70% of MSc and BSc students, respectively). Though there were some critics about the quality and being not up-to-date as can be seen by the following statements: "I am unhappy that they [*the course descriptions*] are not specific enough", "Course descriptions are too old".

Both individual course descriptions mostly got positive feedback from the students that had read the individual descriptions (which was 75% in the Bachelor course and all students for the Master course). The Master course description got a higher satisfaction rate. This could be partly due to a much higher complexity of the Bachelor course which runs over two blocks and thus a longer course description.

Master students are more familiar with ILOs and how to use them

The majority of the participating students are familiar with the concept of the Intended Learning Outcome with 55% and 73% for BSc and MSc students, respectively. The value for the BSc students increased to 74% in the second questionnaire. Both groups answered with a similar percentage that they use the ILOs to choose a course that fit their interests (45.5%, (56% 2^{nd} questionnaire) for BSc and 43.5% for MSc). Remarkably, Master students answered more often that they actually consider ILOs as helpful for exam preparation (14.7% (13% 2^{nd}) for BSc and 54.5% for MSc). An additional question in the Master course questionnaire also pointed out that stating ILOs helps focusing on the relevant information taught (65% agreed) while at the same time not distracting from other interesting facts or information (65%).

Student self-evaluation of acquired knowledge

The second part of the questionnaires for the Bachelor course focused more closely on the actual ILOs specified in the course description. Here, the students were asked to evaluate how much of the ILOs they thought they already had acquired after the first half of the course. This was re-evaluated at the end of the course. The questions were identical in both questionnaires about the specific ILOs and contained ILOs that are mainly taught in the first or second half of the course or throughout the whole course. This made it possible to evaluate if there was increased learning throughout the course and to identify potential problems with ILOs and alignment with teaching activities.

In general, the results indicated that the students increased their learning outcome throughout the course with higher understanding at the end of the course. Almost all questions were answered positively at the end of the course which indicates that additional knowledge was acquired in the second half of the course. Nevertheless, there was some discrepancy between what was taught on the first half of the course and the student's answer about what they had learned. Two ILOs were indicative for this as they are mainly taught in the second part of the course. More than 50% answered that they had already learned “Understand the basic idea of how to plan and carry out project-oriented experimental work from problem definition to final report” and 31% stated that they had learned the “Formulation of scientific questions and hypotheses”. Both are taught specifically in the second part where the students apply knowledge and techniques from the first part of the course. Still, about 23% had answered both questions with “Not taught yet” in the first questionnaire while both questions got 100% “yes” in the second evaluation. There were only two of the chosen ILOs in the questionnaire that got a “not taught” in the second questionnaire (both with 4.3% = answer of 1 student). One of them covering the ethical principles of scientific investigations was more troublesome as 26% of the students stated that they did not learn this.

Apart from this the results from the ILOs showed that most students were rather confident with their learning achievements. The majority of the students made a mark at “I agree” (up to 77%) or even at “I strongly agree” (up to 37%) for the achievement of most of the other ILOs. This was also reflected by the answers for the last set of questions covering the satisfaction with the learning outcome and expectations for the second part of the course. Here, 73% answered that they were happy with the learning outcome from the first part of the course. Another 24% were undecided. 75% stated that the course was as expected. And 94% of the students were confident that they would learn the other ILOs during the second part of the course. In contrast to this 54% stated that the missing ILOs had been taught during the second part of the course while 9% disagreed and 37% were undecided. Nevertheless, all students stated that they were happy with their learning outcome.

Discussion

This project was conducted to get an insight into how students perceive course descriptions and if they consider them as helpful. In a similar way the usefulness of ILOs was evaluated on two courses taught at the Faculty of Science.

Course descriptions as tools for choosing courses

The results showed that most students at the University of Copenhagen are aware of the existence of course descriptions and that they can help them to find suitable courses for their study program. Especially Master students seem to use course descriptions for orientation and to find suitable courses for their study program. This might be partly related to a higher degree of freedom of choice for Master students in comparison to Bachelor programs. Nevertheless, there still are a number of students not aware of course descriptions or just ignoring/not reading them for unknown reasons. Especially for the Bachelor course this was a bit surprising as the course description was handed out to the students together with other course materials at the beginning of the course. In the future it might be necessary to point out the relevance of the course description for a potentially better learning success outcome.

ILOs – perception difference between BSc and MSc students

The results on ILOs in both questionnaires showed that the majority of students know about ILOs though more Master students were more aware of ILOs than Bachelor students. Master students also seem to have a greater understanding of how to use ILOs for their learning outcome in general. This might be related to the fact that they are more advanced in their studies and have greater experience in how to use the available resource for successful learning. This might be reflected in the higher number of Master students thinking that ILOs are helpful for exam preparations which might be a result of experience with previous courses. Here, it would be helpful to know if this is a general learning process on the structure of course description and ILOs and how to decipher them or if this is just a coincidence based on the different study programs.

BSc student's perception of their own learning mostly in agreement with ILOs

In general, there was a good alignment between the intended and the achieved learning outcome. This is based on the student's own perception but is also partly reflected by the results from the written assessment and the oral exam at the end of the course. Most of the ILOs that had been taught during the first half of the course were answered positively in the first questionnaire. And ILOs mainly taught during the second part of the course were achieved in the second half of the course. Nevertheless, there is of course always a discrepancy between a self-evaluation and the outcome of a formal assessment when the level of understanding is evaluated. Here, deep learning can be better differentiated from superficial learning. Such a discrepancy might be indicated by the fact that some students already after the first half of the course positively answered two ILOs that were mainly taught during the second half of the course. Another measure was the outcome from the written exam after the first part and the oral exam at the end of the course. Here, a wide range of grades was covered indicating that deep learning was not always achieved (Personal communication with the course responsible).

Conclusion and outlook

In summary it can be said that the questionnaires highlight that students are aware of two the tools course description and ILOs. They are considered as useful for learning and choosing course from students who know about them. Nevertheless, it might be necessary to increase awareness and point out how students can exploit them for improving their learning outcome.

The presented work could become the starting point for an "action research spiral" (Kember & Kelly 1993, Biggs & Tang 2011) which consists of four stages: "reflect-plan-apply-evaluate". The current stage for the evaluated Bachelor course would be the transition from "reflection" to "planning". Of course, it would be always difficult to implement changes that change the basic structure of a course. Nevertheless, it would be possible to implement changes on a smaller scale such as single lectures, experiments in practical lab exercises and similar teaching activities that do not change the overall nature of a course. Everything else needs careful consideration and longer planning also because course descriptions have to be submitted to KU administration 1 year before a course starts. Though this might hamper fast action after evaluation and reflection it still is possible to implement changes to improve constructive alignment and to facilitate deep learning to increase the student's learning outcome.

29

The theory Y climate applied: Student driven lectures and how a high degree of student freedom can positively influence both teacher and student satisfaction in terms of learning outcomes in a typical human geography course

Sarah Ann Lise D'haen

Department of Geosciences and Natural Resource Management, University of Copenhagen

Introduction

This essay reflects on the format of a course in human geography at the University of Copenhagen. More specifically it investigates how a high degree of student freedom with regard to the content and format of the course was experienced by both the students and the teacher. It thereby focusses on overall learning outcomes and on the alignment between student expectations, teaching activities (TLAs) and assessment. Subject of analysis is the course "Land use transitions in the Global South", for which I am the course responsible.

The focus of this essay is on how both students and teacher experienced the course "Land use transitions in the Global South" in the academic year 2013-2014.

The specific research questions are:

a) How was the overall format of the course experienced by the students?
b) How did students experience the freedom in setting the content of their lectures (but also being subjected to other groups that set the content)?
c) Was the format of the course aligned with student expectations and with the final assessment?
d) How did the teacher experience the course?

Course description

“Land use transitions in the Global South” is a new course that ran for the first time during teaching bloc 1 (September-November) in the academic year 2013-2014. The aim of the course is to provide an overview of the dominant contemporary land use transitions taking place in developing countries. Using case studies from Africa, Asia, Latin America and the Pacific, it explores physical, socio-economic as well as institutional aspects of land use and land use change, and links these to contemporary debates such as economic globalization, global food crises, biofuel production, land grab and nature conservation.

Overall format

The overall course format was designed to facilitated progressive student centred learning over time. Emphasis shifted from initial more teacher facilitated learning to student self-facilitated learning and use and change of concepts (Trigwell, Prosser & Waterhouse 1999). The students in the 2013 course were subjected to the following course scheme (Appendix A):

1. **Teacher driven lectures**
   These lectures were prepared by the teacher, with literature defined by the teacher. The students typically were provided with a session outline beforehand which stated the Intended Learning Outcomes (ILOs), the TLAs and some guiding questions for the readings (Appendix B).

2. **Guest lectures**
   These followed the same scheme as the teacher driven lectures, but were taught by a guest researcher/lecturer. In the 2013 course, two such lectures took place.

3. **Student driven lectures**
   These lectures were effectively a group work exercise. The work consisted of preparing a whole teaching session (including setting the topic, identifying the literature and deciding on the format) per group around the group’s specific topic of interest.

4. **A wrap-up teacher driven lecture**
   A part from summarising what students (felt they) had learned during

the course, the last lecture explored an additional topic that the students wanted to learn more about but that had not been accommodated in the previous lectures.

The final assessment of the course was an essay-based examination (Appendix B). Students were asked to write a 2500 word essay around the topic of their group work. The essay had to be handed in one week prior to the exam date. The 20 minute individual oral examination started with the student briefly presenting (orally, not with e.g. power point) his or her essay, after which a short discussion on the essay took place between the student, the teacher and sometimes the censor. Thereafter the student had to answer/discuss one or two additional questions covering other parts of the course.

Student driven lectures

The student driven lectures could be called “a student focussed strategy aimed at students changing their concepts” (Trigwell, Prosser & Waterhouse 1999). The idea behind these lectures was that an exercise in a small group would motivate the students more in learning about the course subject (Springer et al. 1999). During the actual session, the students presented their topic to their peers in class, and initiated and guided the subsequent discussion. By making students teach each other I hoped to optimise learning (William Glasser quoted in Bigs and Tang, 2011: 86). By allowing students to freely choose their session topics, content, format and fellow group members I aimed to create a so called Theory Y climate (Biggs & Tang 2011). This student freedom was however ‘organised’ by clear guidelines (Appendix D).

Already in the very first session of the course, the students were asked to organise themselves around a particular topic of interest related to the overall course theme. Very broad ‘working topics’ were suggested by the teacher, but students were free to suggest new or different themes. An initial (plenary) brainstorm on the working topics and subsequent group formation according to topic of interest were done in an interactive way during this first session. In the following week, the separate groups had to delineate their topic and identify appropriate scientific literature (corresponding to 3 peer reviewed articles) for their session. Deadline for communicating the final topic and literature was in the third week of the course. Prior to this students received teacher feedback and guidance (literature identification).

In the fourth week of the course students received guidance on the proposed format of their session. The first student driven lecture was held in the fifth week of the course. A typical student session would consist of two parts: a first 'presenting' part consisting of a short student presentation and a clarifying discussion round and a second 'discussion' part with small group discussions and a final plenary discussion. The discussion questions for the second part originated from the presenting group and from an 'opponent' group (Appendix D).

Research methods

To evaluate how students experienced 1) the overall format of the course, and 2) the freedom in setting the student driven lectures, a group interview was held during the last session of the course. All students that followed the course in the mentioned academic year participated. Additional information from the official (anonymous) course evaluation is used. To evaluate the alignment between student expectations of the course, the TLA's and the final assessment, I will present teacher reflections on the development of the course and the performances of the students both during the student driven lectures and at the final assessment.

Results

Students' experiences

Overall format

The results of the focus group interview held during the last session of the course indicated that, overall, the students found the format of the course appealing. Students comments in the official evaluation were: "Good discussions and room for influence", "The teacher seems to have given a great deal of thought to how and where improvements can be made so the students have the best learning outcome" and "Good, relevant literature and subjects covered" (Universitet 2013). Other parts of the official course evaluation reveal that students experienced a good coherence between the different parts of the course, that they felt they had achieved the competences promised in the course description, and that the work load had not been too high (or low). With respect to the student driven lectures, most students held the opinion that the group work stimulated them in profoundly investigating, debating (within the group) and gaining in-depth knowledge of a specific topic. This was something that would not so easily have happened with ordinary teacher driven lectures, according to the students.

Challenges

The following challenges were identified with respect to the student driven lectures: 1) variation in the academic level of presentations of different groups, 2) pace of the discussion during the student sessions and the challenge for students to distil the main messages of the discussion, 3) motivation for reading/preparing for other groups' sessions. With respect to the first challenge, some students expressed their need for a short supportive presentation of the teacher on the topic of the day. This presentation would serve the purpose of framing the discussion presented by that day's group. Emphasis should be on the theoretical and historical background of the topic. The second issue refers to the difficulty students experienced when they were trying to actively participate in a lively discussion and simultaneous annotate what was being said. A part from the presented material (typical power point or Prezi slides) of the presenting group, no written material was provided on the session. Many of the important background or contextual discussions after the presentation were exclusively oral. As a teacher I took notes on what was omitted in the presentation and what aspects of the topic needed to be more thoroughly discussed during the remainder of the session. I then introduced these issues during the discussion. However, students found it very hard to note these points down and at the same time participate in the discussion. One suggested solution was that the presenting group should take notes of the discussion, and post these on the virtual classroom, Absalon, to everyone's benefit. Finally the students declared that they had not been so motivated to prepare and read up on the other groups' sessions since they were not sure what to expect (what (level of participation) would be demanded of them during the session) and because the final assessment focussed predominantly on their own session and the associated essay.

In fact, this last aspect turned out to be a major concern of the students. It was suggested that the topic of the essay should be freer and perhaps even compulsory different from the group work topic. Students said it was 'boring' to work on the same topic. Another general remark was that the guiding questions for the reading for both the student and the teacher driven lectures (posted on Absalon before each session, see Appendix B) were too specific. Several students expressed the wish for more in-depth, analytical questions. They argued that this would motivate them to read the whole text rather than to look for the answer to the specific questions.

Teacher reflection

Development of the course and overall alignment

As a teacher I was overall very satisfied with this course. Students showed enthusiasm for the proposed course format and were genuinely eager to get started on the group work. All groups kept the deadlines for identifying literature, posting presentations online and sending in essays. All groups successfully prepared and conducted a student driven session and participation rates were high throughout the course. The overall level of the essays was good and most students performed well, if not very well on the exam. Students felt confident talking about their essays and discussing the two additional questions during the oral examination.

Potential improvements to the format

As indicated by the group discussion in the last session, there is room for improvement. With respect to the student driven sessions, I agree with the students that the academic level of the different sessions was subject to variation. It is hence valid and useful to reflect on how a more homogenous output can be achieved or at least how a more homogenous overview of the different topics can be achieved. A short teacher presentation could indeed accommodate any 'missing links' in the group presentation. Another solution could be to present and discuss these 'missing links' explicitly at the whiteboard after the group presentation. A written (e.g. bullet points on the white board) final wrap up at the end of each session could then include these missing links and could to a great extent also accommodate the second challenge identified by the students: combining participation in the discussion and taking notes. This wrap-up summary could, as suggested by the students, be written up in a document and posted on Absalon by the presenting group. The third student concern, the motivation of students to prepare for one of the other group work topics and the related remark that it would be more interesting to write the essay on a different topic than one's own group work, was addressed instantly during the course. Once I realised that several students had the same desire, I released the requirement that the essay had to be on the group work topic. This happened in the last teaching session as a direct result of students' remarks during the plenary evaluation discussion. It was still in time for most students' essays, since these were due one week later and since most students had not started on their essays yet. However, I will make the essay topic free in next year's course. The essay can then be on any topic related to the topics discussed during the course and still has to show a clear connection to the course. Finally, I will accommodate the student wish for more analytical questions as guidance to the weekly readings.

Additional teacher reflections

In my opinion, the careful planning of the introductory session was crucial for the success of the course (Appendix E). This session served the purpose of identifying and discussing student and teacher expectations and responsibilities. This was done by: 1) explicitly communicating and discussing the structure of the course, of the group work and of the final assessment, 2) asking students explicitly about their expectations and by emphasizing that they could (and were in fact expected to) influence the content of the course, hence giving students a sense of ownership of the course and 3) initiating group interactions for the student driven sessions through a plenary brainstorming exercise. Ample time was reserved for student remarks and questions throughout. Contrary to previous courses, I received very few additional questions and queries from the students during the remainder of the course, indicating that mutual expectations and responsibilities of teacher and students were sufficiently clear from the first session. Finally, the first session was very helpful for the teacher to get a feel for student motivation, dedication and drive. Further along the course, the practical session for literature identification (session 3, see Appendix A) gave me an insight in group dynamics and allowed me to guide the different groups in their topic discussions and in planning their session. The group consultation session (session 7) further supported these processes.

More importantly perhaps, I feel that an open teacher – student communication formed the basis for mutual satisfaction. I found the students motivated and cooperative throughout and students were not shy in suggesting improvements to the course or session format along the way and in willingly implementing them.

Example of a successful student suggestion for format improvements along the way

The discussion part of the first student driven session proved to be too time-demanding (see appendix 4 for the initial format of the discussion part of the student driven sessions). The students then suggested two improvements: 1) to immediately mix the groups (i.e. to skip the step with the 'specialized' groups), and 2) to distribute the various questions among the discussion groups and then discuss the results of the questions in plenary afterwards (instead of each group going through all the discussion questions). We successfully implemented this during the second student session and kept the new format for the remainder of the course.

Conclusion

Overall, both students and teacher showed a high degree of satisfaction with the current format of "Land Use Transitions in the Global South". The general good performance of the students both on the group work and on the final essay and examination suggests that the course format aligned ILO's, TLA's and final assessment. A Theory Y climate was realised as indicated by overall student enthusiasm and a positive evaluation of the student driven lectures. A comprehensive introductory session setting out clear guidelines and presenting the overall course framework within which student freedom could be exercised were very helpful for the overall success of the course. The theory Y climate for student learning may, in this particular case, be further improved by 1) giving students the freedom to determine the topic of the essay, and 2) inserting a little more teacher guidance in extracting the main points of the student lectures. Finally, the results of this study suggest that a general open communication between students and teacher throughout the course is a premise for successful student engagement and motivation, and ultimately for obtaining the intended learning outcomes.

A Course outline for "Land use transitions in the Global South"

17/09/2013

Land use transitions in the Global South

Course outline Blok 1, 2013.
Teaching times: Mondays: 13.00h - 15.10h, room 11
Wednesdays: 13.15h – 15.25h, room 11
Teacher: Sarah Ann Lise D'haen

Week	Date	Theme	Deadlines
		PART 1: INTRODUCTION	
36	2/09	Session 1: • **Introduction, course outline, and assessment information** • Student interests and expectations • Practical information about group work sessions • Land use change/transition: Main concepts and definitions Literature: • Lambin, Geist and Rindfuss (2006), 8 pages • Ramankutty et al. (2006), 30 pages	
	4/09	Session 2: • **Land use transition: what, how, when?** a general overview pathways of change conditions for land use transition impacts of land use transitions Literature: • Foley et al. (2005), 5 pages • Geist et al. (2006), 39 pages	Group formation and registration for group work sessions
37	9/09	Session 3: • **Group work preparation session** (with teacher present) Identification of relevant scientific literature Brainstorm on session format	
	11/09	Session 4: • **Measuring land use transitions and detecting land use change with remote sensing** Guest lecture by Rasmus Fensholt, IGN, KU Literature: • Martinez and Mollicone (2012), 22 pages	

17/09/2013

38	16/09	Session 5: • **Land use planning: Top-down versus participatory approaches** Guest lecture by Torben Birch-Thomsen, IGN, KU Literature: • Dalal-Clayton, Dent and Dubois (2003b), 31 pages • Dalal-Clayton, Dent and Dubois (2003a), 42 pages • Birch-Thomsen and Kristensen (2005), 14 pages Further literature: • Agergaard and Birch-Thomsen (2006) • Bourgoin, Castella, Pullar, Lestrelin and Bouahom (2012)	Deadline for suggesting a topic for the last session Deadline for submission of literature list for group work sessions
	18/09	Session 6: • **Land degradation. Case studies from East Asia** Literature: • Lestrelin (2010), 16 pages • Heerink, Spoor and Qu (2007), 35 pages • Meyfroidt and Lambin (2009), 6 pages Further literature: • Blaikie and Brookfield (1987)	

PART 2: CONDITIONS FOR LAND USE TRANSITIONS			
39	23/09	Session 7: • Group work consultation time • No teaching	Deadline for group 1 to put the outline of their presentation online
	25/09	Session 8: • **Land tenure and resource rights, general debate and empirical examples from REDD implementation** Literature: • Deininger (2003), 32 pages • Bromley (2009), 7 pages • Naughton-Treves and Day (2012), pages 1-3, 8-7 (5 pages) and 1 selected case study (approx. 7-9 pages)	Deadline for group 2 to put the outline of their presentation online
40	30/09	Session 9: • **Group 1: Global value chains, cash crops, biofuels, feed** crops (globalisation) • Discussion with opponent group 4 and fellow students Literature: • van Gelder and Dros (2002), (not 5; 3.2-3.4) 53 pages	Deadline for group 3 to put the outline of their presentation online

17/09/2013

<table>
<tr><td></td><td></td><td>Macedo et al. (2012), 6 pages
Garrett, Lambin and Naylor (2013), 11 pages</td><td></td></tr>
<tr><td></td><td>2/10</td><td>Session 10:
Group 2: Land acquisitions in the Global South (globalisation)
Discussion with opponent group 5 and fellow students
Literature:
Cotula and Vermeulen (2011), 8 pages
Fairhead, Leach and Scoones (2012), 24 pages
Zoomers (2010), 18 pages</td><td>Deadline for group 4 to put the outline of their presentation online</td></tr>
<tr><td rowspan="2">41</td><td>7/10</td><td>Session 11:
Group 3: Urbanisation and rural-urban interactions (economic development)
Discussion with opponent group 1 and fellow students
Literature:
Padoch et al. (2008), 14 pages
McGregor, Adam-Bradford, Thompson and Simon (2011), 16 pages
Simon, McGregor and Nsiah-Gyabaah (2004), 13 pages</td><td>Deadline for group 5 to put the outline of their presentation online</td></tr>
<tr><td>9/10</td><td>Session 12:
Group 4: Community driven change
Discussion with the opponent group 2 and fellow students
Literature:
Kellert, Mehta, Ebbin and Lichtenfeld (2000), 10 pages
Hajjar, McGrath, Kozak and Innes (2011), 10 pages
Blaikie (2006), 15 pages</td><td></td></tr>
<tr><td>42</td><td></td><td>Holiday, no teaching</td><td></td></tr>
<tr><td>43</td><td>21/10</td><td>Session 13:
Group 5: Climate change and land systems (degradation)
Discussion with the opponent group 3 and fellow students
Literature:
Thomas, Twyman, Osbahr and Hewitson (2007), 21 pages
Morton (2007), 6 pages
Ericksen et al. (2011), 50 pages</td><td></td></tr>
<tr><td></td><td>23/10</td><td>Session 14:
Broader discussion on global land availability and the food versus fuel debate
Wrap up and question time
Suggested literature:</td><td></td></tr>
</table>

17/09/2013

		• Rudel (2013), 8 pages • Lambin (2012), 4 pages • Ellis et al. (2013), 8 pages	
44	28/10	Essay preparation time	
	30/10	Essay hand in at 11 am. Three copies in room 04.1.411	Essay hand in
45	6/11	**Oral examination**	

Literature list

Agergaard, J., Birch-Thomsen, T., (2006). Transitional rural landscapes: The role of small-scale commercial farming in former homelands of Post-Apartheid KwaZulu-Natal. *Danish Journal of Geography* 106(2), 87-102

Birch-Thomsen, T., Kristensen, S. B. P., (2005). Planning with complexity – how do we deal with stakeholder and spatial heterogeneity in land use planning? *Geografisk Tidsskrift-Danish Journal of Geography* 105(2), 23-37

Blaikie, P., (2006). Is small really beautiful? Community-based natural resource management in Malawi and Botswana. *World Development* 34(11), 1942-1957. DOI 10.1016/j.worlddev.2005.11.023

Blaikie, P., Brookfield, H., (1987). Defining and debating the problem. In P. Blaikie and H. Brookfield (Eds.) *Land Degradation and Society*. Routledge, London, 1-26.

Bourgoin, J., Castella, J. C., Pullar, D., Lestrelin, G., Bouahom, B., (2012). Toward a land zoning negotiation support platform: "Tips and tricks" for participatory land use planning in Laos. *Landscape and Urban Planning* 104(2), 270-278. DOI 10.1016/j.landurbplan.2011.11.008

Bromley, Daniel W., (2009). Formalising property relations in the developing world: The wrong prescription for the wrong malady. *Land Use Policy* 26(1), 20-27. http://dx.doi.org/10.1016/j.landusepol.2008.02.003

Cotula, L., Vermeulen, S., (2011). Contects and Procedures for Farmland Acquisitions in Africa: What outcomes for local people? *Development* 54(1), 40-48. 10.1057/dev.2010.94

Dalal-Clayton, B., Dent, D., Dubois, O., (2003a). Approaches to participation in planning. In B. Dalal-Clayton, D. Dent and O. Dubois (Eds.) *Rural planning in developing countries: supporting natural resource management and sustainable livelihoods*. Earthscan Publications Ltd, 90-132.

Dalal-Clayton, B., Dent, D., Dubois, O., (2003b). Conventional, technical planning approaches. In B. Dalal-Clayton, D. Dent and O. Dubois (Eds.) *Rural planning in developping countries: supporting natural resource management and sustainable livelihoods*. Earthscan Publications, 29-89.

Deininger, K., (2003). *Land Policies for Growth and Poverty Reduction*. World Bank and Oxford University Press.

Ellis, Erle C., Kaplan, Jed O., Fuller, Dorian Q., Vavrus, Steve, Klein Goldewijk, Kees, Verburg, Peter H., (2013). Used planet: A global history. *Proceedings of the National Academy of Sciences*. 10.1073/pnas.1217241110

Ericksen, P., Thornton, P., Notenbaert, A., Cramer, L., Jones, P., Herrero, M., (2011). *Mapping hotspots of climate change and food insecurity in the global tropics CCAFS Report no. 5*. CGIAR Research Program on Climate Change, AGriculture and Food Security (CCAFS), Copenhagen, Denmark.

Fairhead, J., Leach, M., Scoones, I., (2012). Green Grabbing: a new appropriation of nature? *Journal of Peasant Studies* 39(2), 237-261. Doi 10.1080/03066150.2012.671770

Foley, J. A., DeFries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., Chapin, F. S., Coe, M. T., Daily, G. C., Gibbs, H. K., Helkowski, J. H., Holloway, T., Howard, E. A., Kucharik, C. J., Monfreda, C., Patz, J. A., Prentice, I. C., Ramankutty, N., Snyder, P. K., (2005). Global consequences of land use. *Science* 309(5734), 570-574. DOI 10.1126/science.1111772

17/09/2013

Garrett, R. D., Lambin, E. F., Naylor, R. L., (2013). Land institutions and supply chain configurations as determinants of soybean planted area and yields in Brazil. *Land Use Policy* 31, 385-396. DOI 10.1016/j.landusepol.2012.08.002

Geist, H., McConnel, W., Lambin, E.F., Moran, E., Alves, D., Rudel, T., (2006). Causes and trajectories of Land-Use/Cover change. In E. F. Lambin and H. J. Geist (Eds.) *Land Use and Land Cover Change*. Springer Verlag, Berlin, 41-70.

Hajjar, R., McGrath, D. G., Kozak, R. A., Innes, J. L., (2011). Framing community forestry challenges with a broader lens: Case studies from the Brazilian Amazon. *Journal of Environmental Management* 92(9), 2159-2169. DOI 10.1016/j.jenvman.2011.03.042

Heerink, N., Spoor, M., Qu, F., (2007). Transition, Economic Policy and Institutional reforms in China and Vietnam. Impact on Sustainable Land Use. . In M. Spoor, N. Heerinck and F. Qu (Eds.) *Dragons with Clay Feet? Transition, Sustainable Land Use, and Rural Environment in China and Vietnam*. Lexington Books, Plymouth, UK, 11-46.

Kellert, S. R., Mehta, J. N., Ebbin, S. A., Lichtenfeld, L. L., (2000). Community natural resource management: Promise, rhetoric, and reality. *Society & Natural Resources* 13(8), 705-715. Doi 10.1080/089419200750035575

Lambin, E.F., Geist, H., Rindfuss, R.R., (2006). Introduction: Local Processes with Global Impacts. In E. F. Lambin and H. Geist (Eds.) *Land Use and Land Cover Change*. Springer Verlag, Berlin, 1-8.

Lambin, Eric F., (2012). Global land availability: Malthus versus Ricardo. *Global Food Security* 1(2), 83-87. http://dx.doi.org/10.1016/j.gfs.2012.11.002

Lestrelin, G., (2010). Land degradation in the Lao PDR: Discourses and policy. *Land Use Policy* 27(2), 424-439. DOI 10.1016/j.landusepol.2009.06.005

Macedo, M. N., DeFries, R. S., Morton, D. C., Stickler, C. M., Galford, G. L., Shimabukuro, Y. E., (2012). Decoupling of deforestation and soy production in the southern Amazon during the late 2000s. *Proceedings of the National Academy of Sciences of the United States of America* 109(4), 1341-1346. DOI 10.1073/pnas.1111374109

Martinez, S., Mollicone, D., (2012). From Land Cover to Land Use: A Methodology to Assess Land Use from Remote Sensing Data. *Remote Sensing* 4, 1024-1045

McGregor, D. F. M., Adam-Bradford, A., Thompson, D. A., Simon, D., (2011). Resource management and agriculture in the periurban interface of Kumasi, Ghana: Problems and prospects. *Singapore Journal of Tropical Geography* 32(3), 382-398. DOI 10.1111/j.1467-9493.2011.00438.x

Meyfroidt, P., Lambin, E. F., (2009). Forest transition in Vietnam and displacement of deforestation abroad. *Proceedings of the National Academy of Sciences of the United States of America* 106(38), 16139-16144. DOI 10.1073/pnas.0904942106

Morton, J. F., (2007). The impact of climate change on smallholder and subsistence agriculture. *Proceedings of the National Academy of Sciences of the United States of America* 104(50), 19680-19685. DOI 10.1073/pnas.0701855104

Naughton-Treves, L, Day, C., (2012). *Lessons about Land Tenure, Forest Governance and REDD+. Case studies from Africa, Asia and Latin America*. UW-Land Tenure Center, Madison, Wisconson.

Padoch, C., Brondizio, E., Costa, S., Pinedo-Vasquez, M., Sears, MRR, Siqueira, A., (2008). Urban Forest and Rural Cities: Multi-sited Households, Consumption Patterns, and Forest Resources in Amazonia. *Ecology and Society* 13(2), 16

Ramankutty, N., Graumlich, L. , Achard, F., Alves, D. , Chhabra, A., DeFries, R.S., Foley, J.A., Gesit, H., Houghton, R.A., Goldewijk, K.K., Lambin, E.F., Millington, A., Rasmussen, K., Reid, R.S., Turner II, B.L., (2006). Global land-cover change: Recent progress, remaining challenges. In E. F. Lambin and H. J. Geist (Eds.) *Land Use and Land Cover Change*. Springer Verlag, Berlin, 9-39.

Rudel, Thomas K., (2013). Food Versus Fuel: Extractive Industries, Insecure Land Tenure, and Gaps in World Food Production. *World Development* 51(0), 62-70. http://dx.doi.org/10.1016/j.worlddev.2013.05.015

Simon, D., McGregor, D., Nsiah-Gyabaah, K., (2004). The changing urban-rural interface of African cities: definitional issues and an application to Kumasi, Ghana. *Environment and Urbanization* 16(2), 235-247. Doi 10.1177/095624780401600214

Thomas, D. S. G., Twyman, C., Osbahr, H., Hewitson, B., (2007). Adaptation to climate change and variability: farmer responses to intra-seasonal precipitation trends in South Africa. *Climatic Change* 83(3), 301-322. DOI 10.1007/s10584-006-9205-4

van Gelder, J.W., Dros, J.M., (2002). *Corporate actors in the South American soy production chain*. World Wide Fund for Nature, Switzerland.

Zoomers, A., (2010). Globalisation and the foreignisation of space: seven processes driving the current global land grab. *Journal of Peasant Studies* 37(2), 429-447. Doi 10.1080/03066151003595325

B Final assessment

02/09/2013

Land use transitions in the Global South

Exam guidelines

- The exam takes place on 6 November 2013
- On the exam, you will briefly orally present (no powerpoint) your essay after which we will have a short discussion about the topic.
- After this you receive 2 or 3 questions about the remainder of the course
- The exam takes 20 min, including grading
- Language: English
- Materials: you are allowed to bring your notes to the exam

C Course outline “Managing the use of land ”

Sarah Ann Lise D’haen
sdh@geo.ku.dk

Assistant Professor
University of Copenhagen
Department of Geosciences and Natural Resource Management
Øster Voldgade 10
1350 Copenhagen K

Copenhagen 19-12-2013

THE THEORY Y CLIMATE APPLIED: STUDENT DRIVEN LECTURES AND HOW A HIGH DEGREE OF STUDENT FREEDOM CAN POSITIVELY INFLUENCE BOTH TEACHER AND STUDENT SATISFACTION IN TERMS OF LEARNING OUTCOMES IN A TYPICAL HUMAN GEOGRAPHY COURSE

1. Introduction

This essay reflects on the format of a course in human geography at the University of Copenhagen. More specifically it investigates how a high degree of student freedom with regard to the content and format of the course was experienced by both the students and the teacher. It thereby focusses on overall learning outcomes and on the alignment between student expectations, teaching activities (TLAs) and assessment. Subject of analysis is the course ‘Land use transitions in the Global South’, for which I am the course responsible.

The focus of this essay is on how both students and teacher experienced the course ‘Land use transitions in the Global South’ in the academic year 2013-2014.

The specific research questions are:

a) How was the overall format of the course experienced by the students?
b) How did students experience the freedom in setting the content of their lectures (but also being subjected to other groups that set the content)?
c) Was the format of the course aligned with student expectations and with the final assessment?
d) How did the teacher experience the course?

2. Course description

‘Land use transitions in the Global South’ is a new course that ran for the first time during teaching bloc 1 (September-November) in the academic year 2013-2014. The aim of the course is to provide an overview of the dominant contemporary land use transitions taking place in developing countries. Using case studies from Africa, Asia, Latin America and the Pacific, it explores physical, socio-economic as well as institutional aspects of land use and land use change, and links these to contemporary debates such as economic globalization, global food crises, biofuel production, land grab and nature conservation.

2.1. Overall format[i]

The overall course format was designed to facilitated progressive student centred learning over time. Emphasis shifted from initial more teacher facilitated learning to student self-facilitated learning and use and change of concepts (Trigwell et al., 1999). The students in the 2013 course were subjected to the following course scheme (Appendix 1):

1) Teacher driven lectures
   These lectures were prepared by the teacher, with literature defined by the teacher. The students typically were provided with a session outline beforehand which stated the Intended Learning Outcomes (ILOs), the TLAs and some guiding questions for the readings (Appendix 2).

49	3/12/12	Session 5: • Land tenure and resource rights, case studies from Sub-Sahara Africa Literature • Benjaminsen et al. (2009), 8 pages • Toulmin (2009), 10 pages • Deininger et al. (2008), 27 pages Additional literature • Fenske (2011), 20 pages • Bassett (2009), 11 pages • Holden et al. (2009), 15 pages
	5/12/12	Session 6: • Preparation time: Group session and essay topics preparation. • Supervision of individual groups after appointment
50	10/12/12	Session 7: • Preparation time: Group session and essay topics preparation. • Supervision of individual groups after appointment
	12/12/12	Session 8: • Land grab • Peter, Morten, Sinne, Line Literature: • Zoomers (2010), 19 pages • Dickson-Hoyle and Reenberg (2009), 8 pages • Robertson and Pinstrup-Andersen (2010), 13 pages • De Schutter (2011), 32 pages • Amanor (2012), 19 pages
51	17/12/12	Session 9: • Biofuels and oil palm • Ninna, Nina, Maja, Mikkel Literature: • Koh and Ghazoul (2008), 11 pages • Gasparatos et al. (2011), 17 pages • McCarthy et al. (2012), 15 pages • Lam et al. (2009), 9 pages • Rathmann et al. (2010), 9 pages
	19/12/12	Session 10: • Climate change and land management • Jonas, Giulia, Ragga, Niels Literature:

		• Nielsen and Reenberg (2010), 10 pages • Vincent (2004), 50 pages • Adger et al. (2003), 16 pages • Lobell et al. (2008), 4 pages • Robledo et al. (2012), 8 pages
52-1	**Holiday**	
2	7/1/13	Session 11: • Exercise: practical issues in researching land use management Material: please bring all literature we have discussed in the course so far for this exercise Literature: • Castella et al. (2007), 15 pages • Dalal-Clayton et al. (2003b): Chapter 2, 31 pages
	9/1/13 *Exceptionally only from 15-16h*	Session 12: • Future land use scenarios using remote sensing. Guest lecture by Rasmus Fensholt Literature: • Martinez and Mollicone (2012), 22 pages
3		Essay preparation time with essay hand in 11 am, Tuesday 15 January. Three copies in room 04.1.411
4	21-24/1/13	Oral examination. 20 minutes including grading, no preparation time.

Page count: 557 pages

Literature list

Adger, W. N., Huq, S., Brown, K., Conway, D., Hulme, M., 2003. Adaptation to climate change in the developing world. Progress in Development Studies 3(3), 179-195.

Amanor, K. S., 2012. Global resource grabs, agribusiness concentration and the smallholder: two West African case studies. Journal of Peasant Studies 39(3-4), 731-749.

Bassett, T. J., 2009. Mobile pastoralism on the brink of land privatization in Northern Cote d'Ivoire. Geoforum 40(5), 756-766.

Benjaminsen, T. A., Holden, S., Lund, C., Sjaastad, E., 2009. Formalisation of land rights: Some empirical evidence from Mali, Niger and South Africa. Land Use Policy 26(1), 28-35.

Blaikie, P., Brookfield, H., 1987. Defining and debating the problem. In P. Blaikie and H. Brookfield (Eds.) Land Degradation and Society. Routledge, London, 1-26.

Bourgoin, J., Castella, J. C., Pullar, D., Lestrelin, G., Bouahom, B., 2012. Toward a land zoning negotiation support platform: "Tips and tricks" for participatory land use planning in Laos. Landscape and Urban

Planning 104(2), 270-278.

Castella, J. C., Kam, S. P., Quang, D. D., Verburg, P. H., Hoanh, C. T., 2007. Combining top-down and, bottom-up modelling approaches of land use/cover change to support public policies: Application to sustainable management of natural resources in northern Vietnam. Land Use Policy 24(3), 531-545.

Dalal-Clayton, B., Dent, D., Dubois, O., 2003a. Approaches to participation in planning. In B. Dalal-Clayton, D. Dent and O. Dubois (Eds.) Rural planning in developing countries: supporting natural resource management and sustainable livelihoods. Earthscan Publications Ltd, 90-132.

Dalal-Clayton, B., Dent, D., Dubois, O., 2003b. Conventional, technical planning approaches. In B. Dalal-Clayton, D. Dent and O. Dubois (Eds.) Rural planning in developping countries: supporting natural resource management and sustainable livelihoods. Earthscan Publications, 29-89.

Dalal-Clayton, B., Dent, D., Dubois, O., 2003c. Lessons from experience. In B. Dalal-Clayton, D. Dent and O. Dubois (Eds.) Rural planning in developing countries: supporting natural resource management and sustainable livelihoods. Earthscan Publications, 1-28.

De Schutter, O., 2011. How not to think of land-grabbing: three critiques of large-scale investments in farmland. Journal of Peasant Studies 38(2), 249-279.

Deininger, K., Ali, D. A., Holden, S., Zevenbergen, J., 2008. Rural Land Certification in Ethiopia: Process, Initial Impact, and Implications for Other African Countries. World Development 36(10), 1786-1812.

Dickson-Hoyle, S., Reenberg, A., 2009. The shrinking globe: Globalisation of food systems and the changing geographies of livestock production. Geografisk Tidsskrift-Danish Journal of Geography 109(1), 105-112.

Fenske, J., 2011. Land tenure and investment incentives: Evidence from West Africa. Journal of Development Economics 95(2), 137-156.

Foley, J. A., DeFries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., Chapin, F. S., Coe, M. T., Daily, G. C., Gibbs, H. K., Helkowski, J. H., Holloway, T., Howard, E. A., Kucharik, C. J., Monfreda, C., Patz, J. A., Prentice, I. C., Ramankutty, N., Snyder, P. K., 2005. Global consequences of land use. Science 309(5734), 570-574.

Gasparatos, A., Stromberg, P., Takeuchi, K., 2011. Biofuels, ecosystem services and human wellbeing: Putting biofuels in the ecosystem services narrative. Agriculture Ecosystems & Environment 142(3-4), 111-128.

Hessel, R., van den Berg, J., Kabore, O., van Kekem, A., Verzandvoort, S., Dipama, J. M., Diallo, B., 2009. Linking participatory and GIS-based land use planning methods: A case study from Burkina Faso. Land Use Policy 26(4), 1162-1172.

Holden, S. T., Deininger, K., Ghebru, H., 2009. Impacts of Low-Cost Land Certification on Investment and Productivity. American Journal of Agricultural Economics 91(2), 359-373.

Karsenty, A., Drigo, I. G., Piketty, M. G., Singer, B., 2008. Regulating industrial forest concessions in Central Africa and South America. Forest Ecology and Management 256(7), 1498-1508.

Koh, L. P., Ghazoul, J., 2008. Biofuels, biodiversity, and people: Understanding the conflicts and finding opportunities. Biological Conservation 141(10), 2450-2460.

Lam, M. K., Tan, K. T., Lee, K. T., Mohamed, A. R., 2009. Malaysian palm oil: Surviving the food versus fuel dispute for a sustainable future. Renewable & Sustainable Energy Reviews 13(6-7), 1456-1464.

Lambin, E. F., Meyfroidt, P., 2010. Land use transitions: Socio-ecological feedback versus socio-economic change. Land Use Policy 27(2), 108-118.

Lambin, E. F., Meyfroidt, P., 2011. Global land use change, economic globalization, and the looming land scarcity. Proceedings of the National Academy of Sciences of the United States of America 108(9), 3465-3472.

Lambin, E. F., Turner, B. L., Geist, H. J., Agbola, S. B., Angelsen, A., Bruce, J. W., Coomes, O. T., Dirzo, R., Fischer, G., Folke, C., George, P. S., Homewood, K., Imbernon, J., Leemans, R., Li, X. B., Moran, E. F., Mortimore, M., Ramakrishnan, P. S., Richards, J. F., Skanes, H., Steffen, W., Stone, G. D., Svedin, U., Veldkamp, T. A., Vogel, C., Xu, J. C., 2001. The causes of land-use and land-cover change: moving

beyond the myths. Global Environmental Change-Human and Policy Dimensions 11(4), 261-269.
Lestrelin, G., 2010. Land degradation in the Lao PDR: Discourses and policy. Land Use Policy 27(2), 424-439.
Lobell, D. B., Burke, M. B., Tebaldi, C., Mastrandrea, M. D., Falcon, W. P., Naylor, R. L., 2008. Prioritizing climate change adaptation needs for food security in 2030. Science 319(5863), 607-610.
Martinez, S., Mollicone, D., 2012. From Land Cover to Land Use: A Methodology to Assess Land Use from Remote Sensing Data. Remote Sensing 4, 1024-1045.
McCarthy, J. F., Gillespie, P., Zen, Z., 2012. Swimming Upstream: Local Indonesian Production Networks in "Globalized" Palm Oil Production. World Development 40(3), 555-569.
Meyfroidt, P., Lambin, E. F., 2009. Forest transition in Vietnam and displacement of deforestation abroad. Proceedings of the National Academy of Sciences of the United States of America 106(38), 16139-16144.
Nielsen, J. O., Reenberg, A., 2010. Temporality and the problem with singling out climate as a current driver of change in a small West African village. Journal of Arid Environments 74(4), 464-474.
Rasmussen, L. V., Reenberg, A., 2012. Land use rationales in desert fringe agriculture. Applied Geography 34, 595-605.
Rathmann, R., Szklo, A., Schaeffer, R., 2010. Land use competition for production of food and liquid biofuels: An analysis of the arguments in the current debate. Renewable Energy 35(1), 14-22.
Reenberg, A., 2012. Insistent dryland narratives: Portraits of knowedge about human-environmental interactions in Sahelian environment policy documents. West African Journal of Applied Ecology 20(1), 97-111.
Reij, C. P., Smaling, E. M. A., 2008. Analyzing successes in agriculture and land management in Sub-Saharan Africa: Is macro-level gloom obscuring positive micro-level change? Land Use Policy 25(3), 410-420.
Robertson, B., Pinstrup-Andersen, P., 2010. Global land acquisition: neo-colonialism or development opportunity? Food Security 2(3), 271-283.
Robledo, C., Clot, N., Hammill, A., Riche, B., 2012. The role of forest ecosystems in community-based coping strategies to climate hazards: Three examples from rural areas in Africa. Forest Policy and Economics 24, 20-28.
Toulmin, C., 2009. Securing land and property rights in sub-Saharan Africa: The role of local institutions. Land Use Policy 26(1), 10-19.
Vincent, K., 2004. Creating an index of social vulnerability to climate change for Africa Working Paper 56. Tyndall Centre for Climate Change Research.
Zoomers, A., 2010. Globalisation and the foreignisation of space: seven processes driving the current global land grab. Journal of Peasant Studies 37(2), 429-447.

D Group work guidelines

02/09/2013

Land use transitions in the Global South

Group work outline

Groups? What, how?

- Work around a theme/topic related to the course, make a choice out of the proposed topics
- From groups of 4 or 5 around a specific topic, 5 groups in total. We will start this process in class in the first session
- Determine the date for your group session together with the other groups in class
- Each group will act as opponents for another group. This means that each group carefully reads the texts and the outline of the presentation of another group and prepares questions and discussion points for the other groups' presentation session. The opponent pairing is as follows:
  4->1 (group 4 is the opponent of group 1), 5->2, 1->3, 2->4, 3->5
- *All* the group sessions and their literature are part of the course curriculum and are material for the examination

Before the group session:

- Post a) an *outline* of your presentation and b) three reflexing questions about the texts on Absalon exactly one week beforehand, so that the opponent group and your fellow students can prepare
- Literature: find your own additional (scientific) literature (e.g. case studies)
  Good sources are: www.sciencedirect.com, http://apps.webofknowledge.com/, and Google scholar
  You get time to start/work on this during one session, on 09/09/13
- Identify 3 key texts that will be part of the curriculum by 16/09/13 the latest
- The *opponent group* comes up with two additional questions by the time of presentation and brings these to the class

During your group session:

- Present and discuss your topic in class – plenary session
- Format:
  - You can choose the form of presentation. This can be a pure oral presentation, a powerpoint, a short film, an illustrative game, etc.
  - Give a short general background about the topic of the session in the introduction. What is it? How important is it globally/regionally, etc?

02/09/2013

  - Make sure you identify in your introduction how the topic relates to the overall course theme, and why it is a relevant topic.
  - Shortly justify why you chose the specific focus of your session and why you think the papers that you selected are representative
  - At the end, make a slide or a sheet of paper which sums up the most important take home messages of (the texts on) your topic.
- After the presentation we will hold a small clarifying question round.
- Thereafter, the class will split up in 4 or 5 groups: the presenting group, the opponent group, and two or three fellow student groups. The presenting group discusses the written questions of the opponent group. The opponent group discusses which additional questions they want to ask the presenting group. The fellow student groups discuss all five questions (the three pre-posted questions from the presenting group, and the two additional questions from the opponent group).
- The next stage is a mixing of the groups into 4-5 new groups, each one composed of 1 presenter, 1 opponent and 2-3 fellow students. All five questions are discussed in these groups.
- The last stage is a plenary session where we compare the different discussions that have been going in the different groups.
- At the end of the session, we will together sum up what the most important points were and what we should take home from this session. For this we take point in departure in the sum up of the presenting group.

Practicalities:

- Brainstorm on a more specific focus of the topics during session 1
- Final group formation in session 2
- Literature identification and preparatory group work session during session 3
- Guidance by teacher in week 39. Each group must come see me.

E Introductory session outline

Land use transitions in the global south

Session 1: Introduction

2 September 2013, 13.15h – 15.30h, Lokal 11, Geoinstitut

Topics:

- Course outline
- Student interests and expectations
- Practical information about group work sessions and assessments
- Land use transitions: Main concepts and definitions

Intended learning outcomes:

At the end of the session you should:

- have a clear idea of how the course is structured
- have a clear idea of what the exam looks like and how the exam is aligned with the course work (group work and essay)
- recognize what is expected of you in terms of reading and preparation for the separate sessions
- be able to carry out preparatory work on the group work i.e. organise yourselves in groups around a specific topic and start discussing practicalities such as when you would like to present

Content wise you should be able to:

- identify the main concepts of land use and land cover change
- recognize the importance of land use/cover changes for the global system
- present the general global land use/cover changes over the last 300 years
- discus the measurement and documentation of land use/cover changes

(It is possible that part of the content-oriented intended outcomes will be achieved in the second session, we will see how we go with the practical matters in the first session)

Activities:

- Conceptual mapping of 'land use transitions in the Global South'
- Expectation of the course: small group exercises
- Brainstorming around group exercise

Readings (to be done *beforehand*):

- Lambin, Geist and Rindfuss (2006), 8 pages in all but focus on sections: 1.2 and 1.3
- Ramankutty et al. (2006), 30 pages

Global bibliography

3rd, H. R. & Butler, A. (2011), 'The critical role of retrieval practice in long-term retention', *Trends in cognitive sciences* **15**, 20–27.

AaU (2014), 'Ecological economics: [5 ects] master course in ecological economics', Pamphlet. Aalborg University Campus Copenhagen.

Airey, J. & Linder, C. (2006), 'Language and the experience of learning university physics in sweden.', *European Journal of Physics* **27(3)**, 553–560.

Akkrediteringsinstitution, D. (2013), 'Akkrediteringsrapport: Kandidatuddannelse i global udvikling.', Københavns Universitet (Høring). Udgivet: www.akkr.dk.

Aleven, V. & Koedinger, K. R. (2002), 'Limitations of student control: Do students know when they need help?', In 5th International Conference on Intelligent Tutoring Systems (ITS). Proceedings, volume 1839 of Lecture Notes in Computer Science, pages 292-303. Springer.

Alford, G. et al. (2006), *Bloom's Taxonomy Overview.*, Innovative Teachers Companion, 176-224. ITC Publications.

Ambrose, S. A. (2013), 'Undergraduate engineering curriculum: The ultimate design challenge', *The Bridge* **43(2)**, 16–23.

Amo, E. & Jareno, F. (2011), *Self, Peer and Teacher Assessment as Active Learning Methods*, Reseach Journal of International Studies-Issue, 41.

Andersen, B. (2010), 'How to enhance student learning by improving the lecture format', KNUD project at the University of Copenhagen.

Barnett, R. G. et al. (2010), 'Conceptualising curriculum change', *Teach. Higher Ed.* **6(4)**, 435–449.

Barton, K. C. (2005), 'Primary sources in history: Breaking through the myths.', *The Phi Delta Kappan* **86:10**, 745–753.

Bates, S. & Galloway, R. (2012), 'The inverted classroom in a large enrolment introductory physics course: a case study', In Proc. HEA STEM Conf.

Beatty, I. et al. (2006), 'Designing effective questions for classroom response system teaching.', *Am J Phys* **74**, 31–39.

Biggs, J. (2003), *Teaching for Quality Learning at University*, New York: Open University Press.

Biggs, J. B. & Collis, K. (1982), *Evaluating the Quality of Learning: the SOLO taxonomy*.

Biggs, J. & Tang, C. (2007), *Teaching for Quality Learning at University*, third edn, Open University Press.

Biggs, J. & Tang, C. (2011), *Teaching for Quality Learning at University*, fourth edn, Open University Press.

Björkman, B. (2011), ‘Pragmatic strategies in english as an academic lingua franca: Ways of achieving communicative effectiveness?’, *Journal of Pragmatics* **43(4)**, 950–964.

Bloom, B. S. et al. (1956), *Taxonomy of educational objectives: The classification of educational goals*.

Bolton, M. (1999), ‘The role of coaching in student teams: A just-in-time approach to learning’, *Journal of Management Education* **23**, 233–250.

Bonwell, C. & Eison, J. (1991), *Active Learning: Creating Excitement in the Classroom*.

Booth, A. (2004), ‘Rethinking the scholarly: Developing the scholarship of teaching in history.’, *Arts & Humanities in Higher Education* **3:3**, 247–266.

Bovill, C. (2014), ‘An investigation of co-created curricula within higher education in the uk, ireland and the usa’, *Innov. Ed. Teach. Int.* **51(1)**, 15–25.

Bovill, C. et al. (2011), ‘Engaging and empowering first-year students through curriculum design: perspectives from the literature’, *Teach. Higher Ed.* **16(2)**, 197–209.

Bowden, J. A. (2004), Capabilities-driven curriculum design, *in* C. Baillie & I. Moore, eds, ‘Effective Learning and Teaching in Engineering’, RoutledgeFalmer.

Braxton, J. M. et al. (2000), ‘The influence of active learning on the college student departure process’, *Journal of Higher Education* **71(5)**, 569–590.

Brown, J. S. (2000), ‘Growing up digital: The web and a new learning ecology.’, *Change* **March/April**, 10–20.

Bryant, R. L. (1992), ‘Political ecology: An emerging research agenda in third world studies’, Political Geography, Vol. 11, No. 1.

Busch, H. et al. (2004), ‘Fremtidens uddannelser. den nye faglighed og dens forudsætninger’, Undervisningsministeriet (www.nyfaglighed.emu.dk).

Butt, A. (2013), *Student Views on the Use of Lecture Time and their Experience with a Flipped Classroom Approach*, Business Education & Accreditation, Forthcoming.

Caldwell, J. E. (2007), ‘Clickers in the large classroom: current research and best-practice tips.’, *CBE life sciences education* **6**, 9–20.

Chapman, E. (2003), ‘Alternative approaches to assessing student engagement rates’, *Practical Assessment, Research & Evaluation* **13**, 1–10.

Cho, K. & MacArthur, C. (2010), ‘Student revision with peer and expert reviewing’, *Learning and Instruction* **20**, 328–338.

Cho, K. & MacArthur, C. (2011), ‘Learning by reviewing’, *Journal of Educational Psychology* **103**, 73–84.

Christiansen, F. & Olsen, L. (2006), ‘Analyse og design af didaktiske situationer’, *MONA* **3**, 7–23.

Corbett, A. T. & Anderson, J. R. (2001), ‘Locus of feedback control in computer-based tutoring: Impact on learning rate achievement and attitudes.’, In SIGCHI Conference on Human Factors in Computing Systems (CHI). Proceedings, pages 245-252. ACM Press.

Cornish, D. & Dukette, D. (2009), *The Essential 20: Twenty Components of an Excellent Health Care Team*, RoseDog Books.

Cowie, B. (2012), *Focusing on the Classroom: Assessment for Learning*, In Second International Handbook of Science Education (pp. 679-690). Springer Netherlands.

Dahl, B. & Troelsen, R. (2013), 4.1. forelæsning, *in* L. Rienecker et al., eds, ‘Universitetspædagogik’, Samfundslitteratur, Frederiksberg, pp. 177–188.

Daly, H. E. & Cobb, J. B. (1989), *For the Common Good. Redirecting the Economy towards Community, the Environment and a Sustainable Future*, Boston, MA: Beacon Press.

de Cillia, R. & Schweiger, T. (2001), ‘English as a language of instruction at austrian universities. in contributions to the sociology of language [csl]’, The Dominance of English as a Language of Science: Effects on Other Languages and Language Communities.

de Graff, E. et al. (2011), *PBL across disciplines: Research into best practice*, Aalborg: Aalborg Universitetsforlag.

Deenadayalan, Y. et al. (2008), ‘How to run an effective journal club: a systematic review’, *J. Evalu. Clin. Prac* **14**.

Desrosiers, P. et al. (1997), ‘Teachers’ assessment practices viewed through the instruments used in physical education classes.’, *Journal of Teaching in Physical Education* **16(2)**, 211–228.

Diamond, S. W. et al. (2008), *Designing and assessing courses and curricula: A practical guide, 3rd ed.*, Jossey-Bass, San Francisco.

Dillenbourg, P. (1999), ‘What do you mean by collaborative learning?’, In Collaborative-learning: Cognitive and Computational Approaches.

Director, S. W. et al. (1995), ‘Reengineering the curriculum: design and analysis of a new undergraduate electrical and computer engineering degree at carnegie mellon university', *Proceedings of the IEEE* **83(9)**, 1246–1269.

Dochy, F. J. R. C. et al. (1999), 'The use of self-, peer and co-assessment in higher education: A review.', *Studies in Higher education* **24(3)**, 331–350.

Donnelly, M. & Norton, C. (2011), *Doing History*, London: Routledge.

Draper, S. W. & Brown, M. I. (2004), 'Increasing interactivity in lectures using an electronic voting system.', *J Comput Assist Lear* **20**, 81–94.

Dysthe, O. & Samara, A. (2006), *Forskningsveiledning paa master og doktorgradnivaa*, Oslo: Abstrakt Forlag.

Elliott, M. J. et al. (2008), 'The role of the laboratory in chemistry instruction', *Journal of Chemical Education* **85**, 145–149.

Ellis, D. et al. (2011), 'Task force report on deep learning', https://uwaterloo.ca/centre-for-teaching-excellence/sites/ca.centre-for-teaching-excellence/files/uploads/files/Task%20Force%20Report%20on%20Deep%20Learning_0.pdf.

Engstrom, C. (2008), 'Curricular learning communities and unprepared students: How faculty can provide a foundation for success.', *New Directions For Teaching & Learning* **2008(115)**, 5–19.

Entwhistle, N. (2009), *Teaching for understanding at university*.

Esfandiari, R. & Myford, C. M. (2013), 'Severity differences among self-assessors, peer-assessors, and teacher assessors rating efl essays.', *Assessing Writing* **18(2)**, 111–131.

Fallows, S. & Chandramohan, B. (2001), 'Multiple approaches to assessment: reflections on use of tutor, peer and self-assessment.', *Teaching in Higher Education* **6(2)**, 229–246.

Frederick, P. (1999), 'Thinking historically: Challenges and solutions', In Perspectives on Teaching Innovations: Teaching to Think Historically (pp. 3-7). Washington DC: American Historical Association.

Freeman, S. et al. (2014), 'Active learning increases student performance inscience, engineering, and mathematics', Available at http://www.pnas.org/content/111/23/8410.

Gatfield, T. (2005), 'An investigation into phd supervisory management styles: Development of a dynamic conceptual model and its managerial implications', *Journal of Higher Education Policy and Management* **27(3)**, 311–325.

Gibbs, G. (1981), 'Twenty terrible reasons for lecturing', *SCED Occasional Paper* **8**(8).

Gibbs, G. & Simpson, C. (2004), ‘Conditions under which assessment supports students’ learning.’, *Teaching and Learning in Higher Education* **16(1)**, 3–31.

Grimson, J. (2010), ‘Re-engineering the curriculum for the 21st century’, *Eur. J, Eng. Ed.* **27(1)**, 31–37.

Grønbæk, N. & Winsløw, C. (2003), *DidakTips 1: Kompetencebeskrivelse i universitetets virkelighed*, Department of Science Education, Faculty of Science.

Gunnarsson, C. (1991), ‘What is new and what is institutional in the new institutional economics’, Scandinavian Economic History Review.

Gurr, G. M. (2001), ‘Negotiating the “rackety bridge” - a dynamic model for aligning supervisory style with research student development’, *Higher Education Research & Development* **20(1**, 81–92.

Hall, R. H. et al. (2005), A student response system for increasing engagement, motivation, and learning in high enrollment lectures., *in* ‘Proceedings of the Eleventh Americas Conference on Information Systems’, Omaha, NE, USA.

Hattie, J. A. C. (2009), *Visible learning: A synthesis of 800+ meta-analyses on Achievement*.

Hattie, J. & Timberley, H. (2007), *The Power of Feedback*.

Hellekjær, G. (2010), ‘Lecture comprehension in english-medium higher education.’, *Journal of Language and Communication Studies* **45**, 11–34.

hendriks, M. et al. (2010), ‘Teaching logic using a state-of-the-art proof assistant’, *Acta Didactica Napocensia* **3(2)**, 35–48.

Hills, J. M. et al. (2010), ‘Bridging the gap between degree programme curricula and employability through implementation of work-related learning’, *Teach. Higher Ed.* **8(2)**, 211–231.

Holst, P. J. et al. (2014), *Bridging lessons with online quizzes*.

Horst, S. et al. (2013), 6.2. evaluering af undervising, *in* L. Rienecker et al., eds, ‘Universitetspædagogik’, Samfundslitteratur, Frederiksberg, pp. 409–422.

Huertas, A. (2011), ‘Ten years of computer-based tutors for teaching logic 2000-2010: Lessons learned.’, In 3rd International Congress on Tools for Teaching Logic (TICTTL). Proceedings, volume 6680 of Lecture Notes in Artificial Intelligence, pages 131-140. Springer.

Iyengar, R. et al. (2008), ‘Inquiry learning. integrating content detail and critical reasoning by peer review’, *Science* **5867**.

Johnstone, A. H. & Al-Shuaili, A. (2001), ‘Learning in the laboratory; some thoughts from the literature’, *University Chemistry Education* **5**, 42–51.

K. A. Smith, S. D. Sheppard, D. W. J. & Johnson, R. T. (2005), ‘Pedagogies of engagement: Classroom-based practices’, *Journal of Engineering Education* **94**, 87–101.

Kember, D. & Kelly, M. (1993), ‘Improving teaching through action research.’, Green Guide No. 14 Campbelltown, NSW: Higher Education Research and Development Society of Australasia.

Kempa, R. F. & Ward, J. E. (1988), ‘Observational thresholds in school chemistry’, *International Journal of Science Education* **10**, 275–284.

Kluger, A. N. & DeNisi, A. (1996), ‘The effects of feedback interventions on performance: A historical review, a meta- analysis, and a preliminary feedback intervention theory’, *Psychological Bulletin* **19(2)**, 254–284.

Knight, P. T. (2010), ‘Complexity and curriculum: A process approach to curriculum-making’, *Teach. Higher Ed.* **6(3)**, 369–381.

König, B. et al. (2013), ‘A framework for structuring interdisciplinary research management’, *Research Policy* **42**, 261–272.

Krashen, S. D. (1982), *Principles and practice in second language acquisition (1st ed.). Language teaching methodology series*, Oxford, New York: Pergamon.

Kristensen, N. (2012), Elevating the learning outcome of lectures with audience response systems., *in* ‘Institut for Biokemi og Molekylær Biologi’, pp. 1–169.

Krogh, L. et al. (2013), ‘Casebaseret undervisning’, In: Rienecker, L., Jørgensen, P.S., Dolin, J. & Ingerslev, G.H. (eds). Universitets pædagogik. Samfunds Litteratur, Frederiksberg.

KU (2014), ‘Master of science in global development’, Curriculum approved by the Dean of the Faculty of Social Sciences on 27 November 2013.

Lage, M. J. et al. (2000), ‘Inverting the classroom: A gateway to creating an inclusive learning environment.’, *The Journal of Economic Education* **31(1)**, 30–43.

Lattuca, L. R. & Stark, J. S. (2009), *Shaping the college curriculum: academic plans in context, 2nd ed.*, Jossey-Bass, San Francisco.

Laurillard, D. (2002), *Rethinking University Teaching: a conversational framework for the effective use of learning technologies*.

Layder, D. (1994), *Understanding Social Theory*, SAGE.

Lee, A. G. et al. (2005), 'Using the journal club to teach and assess competence in practice-based learning and improvement: A literature review and recommendation for implementation', *Surv. Ophthalmo* **50**.

Liebman, J. S. (1996), 'Promote active learning during lectures', ORMS Online edition: http://www.orms-today.org/orms-12-96/education.html. Accessed the 22nd of November 2013.

Lindblom-ylanne, S. et al. (2006), 'Self-, peer-and teacher-assessment of student essays.', *Active Learning in Higher Education* **7(1)**, 51–62.

Linzer, M. (1987), 'The journal club and medical education: Over one hundred years of unrecorded history', *Postgrad. Med J* **63**, 475–478.

Ljosland, R. (2011), 'English as an academic lingua franca: Language policies and multilingual practices in a norwegian university.', *Journal of Pragmatics* **43(4)**, 991–1004.

Lopez-Pastor, V. M. et al. (2013), 'Alternative assessment in physical education: a review of international literature.', *Sport, Education and Society* **18(1)**, 57–76.

Manathunga, C. et al. (2011), 'From knowledge acquisition to knowledge production: issues with australian honours curricula', *J. Higher Ed.* **17(2)**, 139–151.

Martinez-Alier, J. & Røpke, I. (2008), 'Recent developments in ecological economics', *Cheltenham, UK: Edward Elgar Publishing, Incorporated* **1**, 13–34.

Mason, B. J. & Bruning, R. (2001), 'Providing feedback in computer-based instruction: What the research tells us. center for instructional innovation, university of nebraska-lincoln.', Available at http://dwb.unl.edu/Edit/MB/MasonBruning.html.

Mathiasen, H. (2013), Clickers, *in* L. Rienecker et al., eds, 'Universitetspædagogik', Samfundslitteratur, Frederiksberg, pp. 281–288.

Mazur, E. (1997), Peer instruction: Getting students to think in class, *in* E. F. Redish & J. S. Rigden, eds, 'The Changing Role of Physics Departments in Modern Universities, Part Two: Sample Classes', AIP Conference Proceedings, American Institute of Physics, pp. 981 – 988.

McDonough, V. (2012), 'Improving journal club: Increasing student discussion and understanding of primary literature in molecular biology through the use of dialectical notes', *Bioche. Mol. Biol. Edu* **40**, 330–332.

McInnis, C. et al. (2001), 'Development of the course experience questionnaire (ceq). technical report, centre for the study of higher education and assessment research centre, university of melbourne.', Available at http://www.cshe.unimelb.edu.au/research/policy_dev/ceq.html.

Meyers, N. M. & Nulty, D. D. (2008), 'How to use (five) curriculum design principles to align authentic learning environments, assessment, students' approaches to thinking and learning outcomes', Assessment and Evaluation in Higher Education.

Millis, B. (2010), 'Promoting deep learning', *IDEA Paper* **47**.

Mørck, A. M. & Rump, C. (2013), 2.2. universitetspædagogiske modeller og principper, *in* L. Rienecker et al., eds, 'Universitetspædagogik', Samfundslitteratur, Frederiksberg, pp. 93–104.

Murray, T. A. (2013), 'Teaching students to read the primary literature using pogil activities', Bioche. Mol. Biol. Edu. DOI: 10.1002/bmb.20765.

Nipkow, T. (2012), 'Teaching semantics with a proof assistant: No more lsd trip proofs.', In 13th International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI). Proceedings, volume 7148 of Lecture Notes in Computer Science, pages 24-38. Springer.

Norges-Forskningsråd (2006), 'Trenger vi nye former for tverrfaglighet og samspill?', Norges Forskningsråd. Oslo.

Nystrand, M. & Gamoran, A. (1991), 'Instructional discourse, student engagement, and literature achievement', *Research in the Teaching of English* **25**, 261–290.

Osborne, J. (2010), 'Arguing to learn in science: The role of collaborative, critical discourse', *Science* **328**, 463.

Pace, D. (2004), 'The amateur in the operating room: History and the scholarship of teaching and learning.', *The American Historical Review* **109:4**, 1171–1192.

Pickles, E. (2011), 'Assessment of students' uses of evidence: shifting the focus from processes to historical reasoning.', *Teaching History* **143**, 52–59.

Portelli, A. (1997), *The Battle of Valle Giulia. Oral History and the Art of Dialogue.*, Wisconsin: The University of Wisconsin Press.

Prince, M. (2004), 'Does active learning work? a review of the research', *J. Engin. Edu.* **93**.

Prosser, M. & Trigwell, K. (1999), *Understanding learning and teaching: the experience in higher education*, Buckingham, Open University Press.

Prosser, M. & Trigwell, K. (2006), 'Confirmatory analysis of the approaches to teaching inventory', *British journal of educational psychology* **76**, 405–419.

Quinn, D. & Reid, I. (2008), ‘Using innovative online quizzes to assist learning’, Available at http://ausweb.scu.edu.au/aw03/papers/quinn/paper.html.

Race, R. (2001), ‘A briefing on self, peer and group assessment’, Assessment Series no. 9. Learning and Teaching Support Network, Generic centre.

Reid, N. & Shah, I. (2007), ‘The role of laboratory work in university chemistry’, *Chemistry Education Research and Practice* **8**, 172–185.

Rienecker, L. & Bruun, J. (2013), ‘Universitetspædagogik’, (Chapter: Feedback).

Rienecker, L. et al. (2005), ‘Studerendes forventninger til og viden om vejledning’, In Rienecker, L., Harboe, T., Jørgensen, P. S. (eds.)Vejledning - en brugsbog for opgave og specialevejledere på videregående uddannelser (Frederiksberg: Samfundslitteratur), 51-68.

Rienecker, L. et al. (2013), *Universitetspædagogik*, Samfundslitteratur.

Rijnsoever, F. J. & Hessels, L. K. (2011), ‘Factors associated with disciplinary and interdisciplinary research collaboration’, *Research Policy* **40**, 463–472.

Roediger, J. K. . H. (2008), ‘The critical importance of retrieval for learning.’, *Science* **319**, 966–968.

Røpke, I. (2005), ‘Trends in the development of ecological economics from the late 1980s to the early 2000s’, *Ecological Economics* **55**, 262–290.

Shaw, P. et al. (2008), ‘Preparing for international masters degrees at stockholm university and the royal institute of technology in stockholm’, ESP in Higher European Education : Integrating Language and Content.

Shute, V. J. (2008), ‘Focus on formative feedback.’, *Review of Educational Research* **78(1)**, 153–189.

Sjøstedt, P. (2013), ‘Hvorfor lade studerende evaluere hinandens og egne skriftlige opgaver?-pilotprojekt fra faget taktik på hærens officersskole’, Forsvarsakademiets forlag, København.

Sluijsmans, D. et al. (1998), ‘Creating a learning environment by using self-, peer-and co-assessment.’, *Learning Environments Research* **1(3)**, 293–319.

Sommer, S. (2013), ‘Constructive alignment assignment’, Adjunktpædagogikum, University of Copenhagen (2014).

Springer, L. et al. (1999), ‘Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis.’, *Review of Educational Research* **69**, 21–51.

Tally, B. & Goldenberg, L. B. (2005), 'Fostering historical thinking with digitized primary sources.', *Journal of Research on Technology in Education* **38**, 1–21.

Tamir, P. (1989), 'Training Teachers to Teach Effectively in the Laboratory', *Science Education* **73**(1), 59 – 69.

Tange, H. (2011), 'English-medium masters' programmes at an austrian university of applied sciences: Attitudes, experiences and challenges.', *Journal of English for Academic Purposes* **10(4)**, 252–270.

Taras, M. (2001), 'The use of tutor feedback and student self-assessment in summative assessment tasks: towards transparency for students and for tutors.', *Assessment & Evaluation in Higher Education* **26(6)**, 605–614.

Taras, M. (2003), 'To feedback or not to feedback in student self-assessment.', *Assessment & Evaluation in Higher Education* **28(5)**, 549–565.

Tatzl, D. (2011), 'English-medium masters' programmes at an austrian university of applied sciences: Attitudes, experiences and challenges.', *Journal of English for Academic Purposes* **10(4)**, 252–270.

Tinto, V. (1993), *Leaving college: Rethinking the causes and cures of student attrition.(2nd ed.).*, Chicago: The University of Chicago Press.

Tosh, J. (2010), *The Practice of History. Aims, methods and new directions in the study of modern history.*, London: Routledge.

Trigwell, K., Prosser, M. & Waterhouse, F. (1999), 'Relations between teachers' approaches to teaching and students' approaches to learning', *Higher Education* **37**, 57 – 70.

Trigwell, K. et al. (1999), 'Relations between teachers' appraoches to teaching and students' approaches to learning', *Higher education* **37**, 57–70.

Turner, B. L. & Fischer-Kowalski, M. (2010), 'Ester boserup: An interdisciplinary visionary relevant for sustainability', PNAS. 2010. Vol. 107.

Udby, L. et al. (n.d.), 'Virtual neutrons for teaching', http://vnt.nmi3.org.

Unesco (2010), 'World social science report. international social science council', Unesco Publishing. Paris.

Universitet, K. (2013), 'Evalueringer. copenhagen: Københavns universitet', Available: https://evaluering.science.ku.dk/Overview/Default.aspx, Accessed 10-12-2013.

Vicens, Q. (2013), 'Building students' knowledge one click at a time', *Læring & Medier* **10**, 1–28.

Wichmann-Hansen, G. et al. (2007), ‘Hvad findes der af litteratur om vejledning? litteratursøgning med fokus påpublicerede, evidensbaserede studier’, *Dansk Universitetspædagogisk Tidsskrift* **3**.

Wichmann-Hansen, G. et al. (2013), ‘Processtyring og kommunikation i vejledningen’, in Rienecker, L., Jørgensen, P. S., Dolin, J., Ingerslev, G. H. (eds.) Universitetspædagogik (Frederiksberg: Samfundslitteratur), 329-350.

Wieman, C. (2008), ‘Clicker resource guide: an instructors guide to the effective use of personal response systems (clickers) in teaching.’, CWSEI UoBC & CU-SEI UoC. Udgivet: http://www.colorado.edu/sei/documents/clickeruse_guide0108.pdf.

Wilk, R. (2012), *The limits of discipline: Towards interdisciplinary food studies*, Physiology & Behavior. Elsevier.

Willis, J. (2007), ‘Assessment for learning-why the theory needs the practice.’, *International Journal of Pedagogies and Learning* **3(2)**, 52–59.

Willis, J. (2011), ‘Affiliation, autonomy and assessment for learning.’, *Assessment in Education: Principles, Policy & Practice* **18(4)**, 399–415.

Wilson, K. L., Lizzio, A. & Ramsden, P. (1997), ‘The development, validation and application of the course experience questionnaire’, *Studies in Higher Education* **22**, 33 – 53.

Wilson, S. & Wineburg, S. (2001), ‘Wrinkles in time and place: Using performance assessments to understand the knowledge of history teachers.’, *Historical thinking and other unnatural acts: Charting the future of teaching the past.* pp. 173–214.

Wineburg, S. (1991), ‘Historical problem solving: A study of the cognitive processes used in the evaluation of documentary and pictorial evidence.’, *Journal of Educational Psychology* **83**, 73–87.

Wineburg, S. (2000), ‘Making historical sense’, In P.N. Stearns, P. Seixas, & S. Wineburg (Eds.), Knowing teaching & learning history: National and international perspectives (pp. 306-326).

Wineburg, S. (2001), *Historical thinking and other unnatural acts: Charting the future of teaching the past.*, Philadelphia: Temple University Press.

Wolf, P. & Hughes(Eds.), J. C. (2008), *Curriculum Development in Higher Education: Faculty-driven Processes and Practices*, Jossey-Bass.

Wood, E. J. (1996), ‘Laboratory work in biochemical education: purpose and practice.’, *Biochemical Education* **24**, 132–137.

Young, B. L. (1979), *Teaching Primary Science*, Longman Group, Harlow.

Zepke, N. & Leach, L. (2010), 'Improving student engagement: Ten proposals for action', *Active Learning in Higher Education* **11**, 167–177.